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AN ANALYSIS OF THE PERSONNEL RESOURCES OF THE DENTAL PROFESSION

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WITH the increased interest in dental health which has been so evident during the last two decades, information as to the number of active dentists in the United States, the death and retirement rates in the dental profession and dentist-population ratios has come to be of pointed significance. The need for consideration of these points in meeting the dental personnel requirements of the armed forces has been marked. This need will likely demand further serious study in association with attempts to appraise the dental resources of the United States in terms of postwar problems. Satisfactory statistical data regarding the dental profession are rare. The following discussion is presented with a view to stimulating interest in the various problems involved, and to indicating certain changes and trends associated with the resources of dentistry.

I

The basic question involved in consideration of the personnel resources of the dental profession has to do with the number of active dentists as related to the present and future public need for their services. Appraisal of these resources, or of dentist-population ratios in terms of the total number of dentists, does not lead to reliable conclusions for the reason that the total dental census includes three groups of dentists: (a) active, (b) partially active and (c) retired. Such a division in terms of age alone might be made, as follows, with each division overlapping somewhat: 25-54, active years; 55-64, period of declining activity; 65 and over, retirement years.

If a work expectancy of thirty years is assumed, the period of greatest activity would be between ages 25 and 54, while the period of partial activity would for the most part be found to begin at 55 years, increasing each year to the time of retirement. It should be clear, of course, that these groupings only roughly define the age limits of complete activity, partial activity and retirement. However, it is probable that

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they closely approximate the actual situation in the dental profession.

The most significant enumeration of active dentists in the United States is that of the Bureau of the Census for April 1940. This enumeration does not include the total number of dentists, but is limited to those who stated that they were employed or were seeking work. Under these two classifications, 70,417 dentists were enumerated. In the 1940 census, 6.7 per cent of the dentists enumerated were over 65 years of age; and it is not very likely that these practitioners, or in fact some of those between the ages of 25 and 65, can be considered fully effective. It appears that a conservative approach to determination of the total number of fully effective dentists could be based on the assumption that the ineffectiveness due to age or to ill health equaled at least 2 per cent of the whole number of dentists. This would mean that the total number of full-time active dentists on April 1, 1940 numbered 69,009.

To estimate the number of active dentists at any time during the intercensal period, it is necessary to know the annual loss by death and retirement, and also the number of additions to the dental profession. In 1940, and prior to the sixteenth census, Miner and I,[1] using a combined annual death and retirement rate of 24 per thousand active dentists, predicted that these dentists would number 71,762 in July 1940, including the graduates of June 1940. If to the U. S. Census enumeration of dentists (70,417) is added 1,754 June 1940 graduates, and if corrections are made for deaths and retirements over the three-months period (April 1 to July 1), a figure of 71,749, or thirteen less than the O'Rourke and Miner prediction, is secured. The close agreement between the census enumeration corrected to July 1940, and the O'Rourke and Miner estimate indicates the reliability of a combined annual death and retirement rate of 24 per thousand active dentists in the decade 1930-1940.

The combined loss rate of 24 per thousand, assumed by O'Rourke and Miner,[1] may be divided into a death and a retirement rate. In the absence of reliable information, it was necessary to arrive at death rates by adjusting the rates for comparable age groups of the general population. At the same time, the annual upward trend in the age composition of dentists was given consideration. The

TABLE 1.—AGE COMPOSITION OF DENTISTS
1920, 1930, 1940

Age Group	1920*		1930†		1940‡		1940, Women#	
	Number	Per Cent	Number	Per Cent	Number	Per Cent	Number	Per Cent
20-24	5,504	9.8	2,879	4.1	773	1.1		
25-44	34,521	61.5	42,302	59.5	36,807	53.1		
45-64	14,400	25.6	23,166	32.6	26,713	38.5		
65 and over	1,619	2.9	2,641	3.7	5,068	7.3		
Unknown	108	0.2	67	0.1				
Total	56,152	100.0	71,055	100.0	69,361	100.0	1,047	100.0

*Compiled from Fourteenth Census of U.S., 1920, Vol. 4, "Occupations," pp. 392-393.
†Compiled from Fifteenth Census of U.S., 1930, Vol. 5, "Occupations," pp. 132-133.
‡Nine persons listed in 18-19 age group; probably dental students; compiled from "Age of Workers in Each Occupation in U.S.," Sixteenth Census, 1940.
#Woman dentists; age not listed.

death rate assumed was 15 per thousand for all active dentists, both men and women. The remainder of the annual combined loss rate of 24 represents the retirement rate of 9 per thousand. While both rates may only roughly approximate actual conditions, the total loss rate of 24 per thousand for the last decade appears to be reliable when appraised in terms of census estimates corrected to July 1940. This does not mean that the combined or separate death and retirement rates can be taken as applying to the decade 1940-1950. Table 1 shows that the age of dentists has been advancing during the last three decades. It is expected to advance farther, and this will mean a greater annual loss by death and retirement.

From a study of death rates by occupation, based on data from the U. S. Census for ten states, 1930, Whitney[2] reported findings in 1934 which would give for "professional men" death rates of 3.16 per thousand for the age group 25-44 and 16.33 for the 45-64 group. If these rates are applied to the dental profession, and if the rate for those of the general population 65 years and over are also used, the annual loss by death among the 69,361 active male dentists over 25 years of age enumerated in the 1940 census would be 14 per thousand. This would be increased but slightly by the deaths occurring in the 20-25 age group, which included 773 dentists. While it is not known whether the death rate for dentists is higher or lower than that for the professional group as a whole, it probably ranks next to that for physicians and surgeons. The rate in the professional group 65 years and over is very slightly less than that of the comparable age group of the general population.

Dorn[3] (1943), in an unpublished report, estimated the crude death rate among the male dentists enumerated in the sixteenth census 1940 as 13 per thousand. The method used in arriving at this rate, shown in Table 2, is described by Dorn as follows:

TABLE 2.—ESTIMATED NUMBER OF DEATHS OF MALE DENTISTS BASED ON 1940 CENSUS*

Age	Death Rate per 1,000†	Adjustment Factor‡	Adjusted Death Rate	Number of Male Dentists 1940	Estimated Number of Deaths in One Year
15-19	1.7	0.72	1.2	9	
20-24	2.3	0.72	1.7	773	1
25-29	2.5	0.72	1.8	6,148	11
30-34	3.1	0.72	2.2	8,792	19
35-39	4.2	0.77	3.2	10,891	35
40-44	6.1	0.77	4.7	11,051	52
45-49	9.2	1.12	10.3	8,828	91
50-54	13.7	1.12	15.3	7,394	113
55-59	20.5	1.01	20.7	5,958	123
60-64	29.8	1.01	30.1	4,514	136
65-69	43.9	1.10	48.3	2,952	138
70-74	65.8	1.00	65.8	1,612	106
75 and over	134.8	1.00	134.8	548	74
Total				69,370	889

*Dorn, H. F: Death and Retirement Rate of Dentists. Unpublished report, February 1943.
†White males, U. S. 1939-1940.
‡Based on ratio of age specific death rates of dentists to those of all males, England and Wales, 1930-1932.

Column 2 contains the age specific death rates of white males in the United States for 1939 and 1940. In column 3 are the ratios of the age specific death rates of all males in England and Wales for the period 1930-1932. If it is assumed that the relative mortality of dentists and all males is the same in the United States, as in England and Wales, estimated age specific death rates for dentists can be calculated by multiplying the corresponding entries in columns 2 and 3. These products are entered in column 4. The number of male dentists enumerated in the 1940 census of population is entered in column 5, and the numbers of deaths obtained by multiplying corresponding entries in columns 4 and 5 are entered in column 6. The number of deaths during one year would be 899. This number divided by the initial number of dentists, 69,370, gives 13 per thousand as the crude death rate of dentists 20 or more years of age.

The estimated death rates in the dental profession can be compared to Whitney's findings for "physicians and surgeons." In this case, the rates were 3.94 for the 24-44 age group and 19.16 for the group 45-64. If these rates, and the rate for the general population 65 and over, are applied to the medical profession, the death rate would have been 20 per thousand for physicians enumerated in the 1940 census. Whatever differences may exist between the death rates in the dental and in the medical profession are due largely to differences in age composition and in occupation. The median age of physicians is somewhat higher than that of dentists. However, there is no information available regarding the probable influence of differences in occupation.

The retirement rate of dentists cannot be accurately determined on the basis of existing data. The rate of 9 per thousand estimated by O'Rourke and Miner[1] was based on the total decennial loss, with the loss beyond that caused by death assumed to be due to retirement because of age, illness or entrance into some other field of activity. Thomas[4] (1938), from a study of reports of secretaries of state boards of dental examiners for the five years 1931-1936, estimated the annual loss by retirement to be 6 per thousand dentists. However, it is probable that many dentists retire and yet continue to hold their license to practice. It is, therefore, probable that the actual retirement rate exceeds the estimate of 6 per thousand. Dorn[3] (1943), from a study of the death and retirement rate in the dental profession, points to certain difficulties which are encountered in attempts to determine these rates by using data from the census of occupations. However, Dorn concludes that "the retirement rate cannot be determined with accuracy, but it

TABLE 3.—NUMBER OF DENTISTS BELOW AND ABOVE AGE OF FORTY-FIVE YEARS
1910, 1920, 1930, 1940

Age Group	1910*		1920†		1930*		1940#	
	Number	Per Cent	Number	Per Cent	Number	Per Cent	Number	Per Cent
Under 45	30,299	77.1	40,025	71.3	45,181	63.6	37,580	52.2
45 and over	9,146	22.9	16,019	28.5	25,807	36.3	31,781	45.8
Unknown			108	0.2	67	0.1		
Total	39.997	100.0	56,152	100.0	71,055	100.0	69,361§	100.0

*Compiled from Thirteenth Census of U.S., 1910.
†Compiled from Fourteenth Census of U.S., 1920, Vol. 4, "Occupations," pp. 392-393.
‡Compiled from Fifteenth Census of U.S., 1930, Vol. 5, "Occupations," pp. 132-133.
#Compiled from "Age of Workers in Each Occupation in U.S.," Sixteenth Census, 1940.
§Does not include women; age group composition for woman dentists not included in census data.

probably is not more than seven per thousand per annum." This estimate was based on the use of a ten-year survival factor and on the assumption that if the estimated number of survivals is larger than the actual number enumerated in the census, the excess can be taken to represent the number of dentists who were retired but still living. Dorn's study did not include a consideration of the probable number of male dentists who left the practice of dentistry to enter some other field. It is not unlikely that the inclusion of this factor would cause the retirement rate to be somewhat in excess of 7 per thousand.

From the studies regarding death and retirement rates, it is evident that estimates regarding the combined rates range from 20 to 24 per thousand active dentists. It is unfortunate that adequate data for determining these rates are not available.

The only accurate method of determining the death and retirement rate of dentists would be to prepare a list of all dentists on a given date. At the end of some period of time such as five or ten years, an investigation could be made to determine the number who were (a) still alive and practicing, (b) still alive but retired and (c) dead. These data in combination with corresponding information for dental graduates during the same period would permit the calculation of death and retirement rates. In the absence of such information it is necessary to prepare estimates from whatever fragmentary data are avaliable.[3]

II

It is not generally realized that the age composition of dentists is changing to a marked extent. This can be noted in Table 1, which gives the age composition of dentists for the last three decades. From 1920 to 1930, there was a decrease of 47.6 per cent in the number of dentists in the 20-24 age group, this decrease continuing to 73.1 per cent between 1930 and 1940. This reduction in the percentage of dentists in the youngest group in undoubtedly due to advances in the requirements for admission to dental schools and to voluntary lengthening of the period of general education.

The number of dentists in the age group 25-44 years increased 22.5 per cent from 1920 to 1930, yet, in this same age group, there was a decrease of 13 per cent from 1930 to 1940. While the number in the two youngest age groups has been decreasing, the number in the two oldest age groups has shown an increase. From 1920 to 1930, the number in the 45-64 age group increased

TABLE 4.—AGE COMPOSITION OF PHYSICIANS
1920, 1930, 1940

Age Group	1920*		1930†		1940†		1940, Women‡	
	Number	Per Cent	Number	Per Cent	Number	Per Cent	Number	Per Cent
20-24	2,432	1.7	2,186	1.4	1,586	1.0	292	3.8
25-44	70,566	48.6	67,083	43.3	80,617	51.1	4,365	56.5
45-64	60,286	41.6	68,787	44.5	57,263	36.3	2,391	30.9
65 and over	11,435	7.9	16,551	10.7	18,282	11.6	684	8.8
Unknown	258	0.2	186	0.1				
Total	144,977	100.0	154,793	100.0	157,748	100.00	7,732	100.0

*Compiled from Fourteenth Census of U.S., 1920, Vol. 4, "Occupations," pp. 392-393.
†Compiled from Fifteenth Census of U.S., 1930, Vol. 5, "Occupations," pp. 132-133.
‡Compiled from "Age of Workers in Each Occupation in U.S.," Sixteenth Census, 1940; twelve physicians listed as of 18-19 age group, probably premedical students.

by 60.9 per cent. However, the increase in this group was only 15.2 per cent from 1930 to 1940. In the age group 65 and and over, the increase during the last two decades has been outstanding, having been 63 per cent from 1920 to 1930 and 91.9 per cent from 1930 to 1940. The change in percentage of dentists below and above 45 years of age, from 1910 to 1940, is shown in Table 3.

Study of Tables 1 and 3 will show that the age group distribution of dentists is gradually coming to approximate that of physicians. The median age of dentists in 1940 was 43.6 as compared with 44.1 for physicians. Because of this advance in median age, it is obvious that the proportion of retired and partially active dentists is increasing, as is also the death rate.

TABLE 5.—ESTIMATED NUMBER OF ACTIVE DENTISTS AND ESTIMATED DENTIST-POPULATION RATIO 1941-1945

Year	Estimated Number Active Dentists	Number of Graduates	Active Dentist-Population Ratio	Population
1941	71,668	1,568	1 : 1,850	132,638,000*
1942	71,762	1,794		
1943	73,820	3,800		
1944	74,153	2,104		
1945	74,473	2,100†	1 : 1,830	136,448,000†
		11,366		
Average number of graduates per year, 1941-1945		2,273		

*Bureau of Census, July 23, 1941, Series P-3, No. 15; "Estimated Future Population by Age and Sex, 1945-1980."

†Estimated.

ratios vary widely among the states, and among the nine geographic divisions.

These wide variations in dentist-population ratios of the various states reflect differences in per capita income, in dental needs and in appreciation of dental health. They also represent differences in the demand for dental care and in ability to support this demand financially. The factors controlling these differences can be broken down further into those which include the character of the population, the per capita expenditure for education, cultural levels, climate and many others. Here, it may be pointed out that the basic factor involved is doubtless economic, for it has long been known that there is a high degree of correlation between per capita income in any area and the effective demand for the various health services. Those states and geographic divisions with the lowest per capita income have the fewest dentists per thousand population. Of course, there is doubtless some variation in the need for dental care. For example, it has been shown that an inverse correlation exists between the prevalence of dental caries and the mean annual hours of sunlight. It is also now quite evident that the fluorine content of the domestic water supply is associated with

III

It has been customary to state the quantitative relationships of dentists to population in terms of dentist-population ratios. While these ratios stated on a national basis indicate broadly the number of dentists available to a certain number of people, they do not carry the significance which they are ordinarily assumed to possess. The reason for this lies in the fact that dentist-population

low-caries prevalence. These, and perhaps other factors, create some difference in the need for dental care, and this difference would, of course, account in part for variations in population-dentist ratios.

With two exceptions, it appears safe to assume that, with the passage of time, the number of dentists in any area has come to be in harmony with the demand for service. The two exceptions to this assumption are as follows: (a) the probable excessive flow of dentists to areas that have high per capita income and offer excellent social, professional and educational advantages, and (b) the probable refusal of dentists to locate in sufficient numbers or at all in communities or areas that do not afford these advantages. For the most part, dentist-population ratios have leveled off throughout the years, and while they may be affected somewhat by the need for dental care, it is doubtless true that a number of other important factors operate to increase or decrease the effective demand for dental service, and, as a consequence, the total dental personnel of any area.

The problem of maintaining the present dentist-population ratio requires consideration not only of the annual deaths and retirements in the dental profession, but also of the rate of population growth, and the number of graduates available each year. While a steadily decreasing rate of population growth is estimated for the next several decades, estimates released by the Bureau of the Census July 1941 forecast a population of 136,448,000 in 1945 and one of 140,561,000 in 1950. However, it is probable that the population increase up to 1945 and 1950 will exceed both of these estimates.

TABLE 6.—ESTIMATED NUMBER OF ACTIVE DENTISTS, 1946-1950, WITH DENTIST-POPULATION RATIO, 1950

Year	Estimated Number Active Dentists
1946	74,959
1947	75,449
1948	75,912
1949	76,364
1950	76,805
Estimated number of graduates required, 1946-1950	11,366
Estimated population, 1950*	140,561,000
Estimated active dentist-population ratio, 1950	1:1,830

*Bureau of Census, July 23, 1941, Series P-3, No. 15; "Estimated Future Population by Age and Sex, 1945-1980."

TABLE 7.—MEDIAN AGE OF POPULATION, 1820-1940

Year	Median Age
1820*	16.7
1830	17.2
1840	17.8
1850	18.8
1860	19.4
1870	20.1
1880	20.9
1890	21.4
1900	22.9
1910	24.0
1920	25.2
1930	26.4
1940†	29.0

*Wilcox, W. F.: 1820-1930, Studies in American Demography. Ithaca, N. Y.: Cornell University Press, 1940, p. 1933.

†U. S. Bureau of Census; "Age Composition of Population," Series P-10, No. 6, April 1942.

On July 1, 1942, the population was estimated to be 133,965,000,[5] an increase of 1,327,000 beyond the estimate of 132,638,000[7] for the preceding January 1. If this rate of increase were maintained, the population would be considerably in excess of the estimates for 1945 and 1950. This recent acceleration of the rate of population growth is due mainly to a rise in the birth rate, although net immigration has accounted for about one-tenth of the increase. It is not very likely that the rate of population increase will continue during the

course of the war. As the size of the armed forces and the number of men stationed abroad increase, the birth rate doubtless will drop abruptly as it did during the first World War. Nevertheless, because of the total increase up to 1943, it is very likely that the population in 1945 and 1950 will exceed the forecasts of January 1941.

On the basis of 71,688 active dentists in 1941, and a population of 132,638,000, the ratio of dentists to population would have been 1:1,850. If we assume a death and retirement rate of 24 per thousand active dentists, and take into consideration the 11,336 graduates from 1941 to 1945 inclusive, the dentist-population ratio in 1945 would be 1:1,830, if the U. S. Bureau of the Census forecast of a population of 136,448,000 is used. These data are summarized in Table 5.

TABLE 8.—AGE COMPOSITION OF POPULATION, 1940*

Age	Total	Per Cent
Under 5 Years	10,541,524	8.0
5-9	10,684,622	8.1
10-14	11,745,935	8.9
15-19	12,333,523	9.4
20-24	11,587,835	8.8
25-29	11,096,638	8.4
30-34	10,242,388	7.8
35-39	9,545,377	7.2
40-44	8,787,843	6.7
45-49	8,255,225	6.3
50-54	7,256,846	5.5
55-59	5,843,865	4.4
60-64	4,728,340	3.6
65-69	3,806,657	2.9
70-74	2,569,532	2.0
75 and over	2,643,125	2.0
Median age	29.0	100.0

*Bureau of Census; "Age Composition of Population, for United States, Urban and Rural and for States." 1940, Series P-10, No. 6.

It is estimated that there will be a yearly average of 2,273 graduates from 1941 to 1945 inclusive (Table 5). With an estimated population of 140,561,000 for 1950, and an annual loss of 24 per thousand active dentists by death and retirement, it will be necessary, as shown in Table 6, to have the same yearly average number of graduates (2,273) in order for a dentist-population ratio of 1:1,830 to exist in 1950. In view of the fact that 15 per cent of first year classes in dental schools fail to complete the course, it would be necessary to admit 2,510 new students each year if the required number of graduates is to be secured.

Another factor which warrants attention in any attempt to evaluate current or future dentist-population ratios is the increase in the median age of the population. As is shown in Table 7, the median age of the population has advanced from 16.7 in 1920 to 29.0 in 1940. This advance in median age has resulted chiefly from increase in the proportions of persons in the upper age groups, and a decrease in the proportions in the younger age groups. Lower birth rates and lower death rates have been major factors in the change, although the decline in immigration in recent years has also caused a reduction in the number of young immigrants. The age composition of the population as of April 1, 1940 is shown in Table 8.

It is important to consider the advance in the median age of the population for the reason that the existence of more people in the older age groups increases the population in the ages at which disease of the supporting tissues and the need for prosthetic service are greatest. Thus, while the dental profession is faced with the growing problem of providing dental care for children, the need for adult dental care is also expanding.

IV

Despite the two growing and somewhat competing problems of adult and child dental care, and the probable future general appreciation of dental health, it is evident that the proportion of dentists to population will not increase

during this decade. To some, the primary solution to the problem thus created will be seen to lie in an increase in the availability of dental care through expansion of professional or auxiliary personnel. It is difficult to support this frequently suggested solution as being basic to considerations of the problems of dental care. These considerations should start, not with questions as to manpower, but rather with those which are concerned with ends, and in this case the end involved is the development of a program that will strike at the roots of the problem. In the light of our modern knowledge, increases in dental personnel can for the most part be justified only as they evolve normally from the demands created by the effective operation of measures for the control of dental disease.

While adequate service should be available to meet the demand for treatment of accumulated dental disease and deficiencies, an increase in personnel based upon anticipated demands for this type of service alone would imply that the resources of dentistry which lie in accumulated knowledge are not sufficient to warrant the development of plans for attacking the problems of dental care primarily at their source. It is true that this knowledge was inadequate not so many years ago. However, the findings of research and clinical experience clearly indicate that substantial control of dental caries is now possible through early inspection and treatment, diet and nutrition, dental hygiene and dental health education. This being true, it seems reasonable to assume that the greatest responsibility on the part of those who are interested in the problem of dental care is the organization and promotion of a program which will eventually reduce the incidence of dental caries, the disease which is the basic source of most dental problems. It is well known that the administration of preventive or control measures is less expensive, more quickly accomplished and more effective than are attempts to meet the needs for gross dental service. Consequently, control service would be within the reach of a greater section of our population. The operation of a broad and effective control program with emphasis on dentistry for children would, with the continued expansion of adult dental needs, place an unusually heavy burden upon the dental profession. Eventually, of course, the need for adult service would be reduced. However, it is clear that, from the successful administration of control measures, because it would after several years involve a larger section of the population, the need would naturally arise for an increase in dental personnel. This does not mean that there would be any reduction in the demands on each practitioner. It would mean that, in addition to the adult dental care essential at that time, the practitioner would be called upon for early inspection and early treatment of a much larger number of young people. Eventually a situation would develop which is described in the following quotation:

> One might draw several parallels in medicine in which the administration of preventive or control services and materials has, in many cases, simply taken the place formerly devoted to treatment, and in which for each person formerly receiving therapeutic service, a thousand are now receiving modern protective service. The whole matter can be reduced to the fact that, when a profession is serving only a small body of the population, the application of new knowledge may broaden its field of service at one point and narrow it at another. In the case of preventive dentistry or caries control, this service would to a certain extent be gradually substituted for other forms of service now common in the field of dentistry. Doubtless, there would be less need for dental care on the part of the individual. On the other hand, more persons would be likely to seek preventive and control service if it were readily available and within their financial reach.[6]

The means is at hand for substantial

control of dental caries through early inspection and treatment by the dentist, through diet, nutrition, hygiene and dental health education. It is suggested that knowledge in these several fields be brought to a focus as component parts of a single program with the single label "caries control." At the present time, there is much confusion on the part of the public owing to the fact that there are several programs, each with a different label. In one case, the chief dependence is on dental hygiene. In another, diet and nutrition are emphasized. In yet other cases, the public has been taught to lean too heavily upon the chemotherapeutic value of dentifrices. There is no doubt that early care is the greatest factor in caries control. However, other widely advocated measures such as diet, dental hygiene and dental health education also make significant contributions. The same is true of tuberculosis control, which involves not only early inspection and treatment, but also a large number of social and economic conditions, all of which require consideration. All of these factors in tuberculosis control have been for some years welded into one well-organized and well-publicized program, which throughout the years has brought about a reduction in the mortality rate from tuberculosis from 201 per hundred thousand in 1900 to 44 per hundred thousand in 1942.

Finally, it may be suggested that while consideration of the manpower resources of dentistry is important, it is of no greater importance than are questions that deal with a shift in emphasis toward the control of dental disease. If it is admitted or implied that some worth while control of dental disease is impossible, the appeal will then probably be one which calls for an increase in the manpower resources of dentistry for the purpose of approaching the problem of dental care from the top instead of at its source. The operation of a control program on a national basis, although it eventually may lead to a normal evolutionary increase in dental personnel, will be more productive of enduring benefits than will any attempt to provide treatment for dental caries and its accumulated effects by increasing dental personnel or by lowering the cost of service. As was suggested by the National Health Program Committee of the American Dental Association[7]:

> Any program of dental care, therefore, that is calculated to have an effect on raising the level of dental health in this country must be accompanied by a program of dental health education, and emphasis in the dental care program itself must be placed on prevention and control. Any other approach to the problem of dental disease is financially unmanageable, uneconomic and scientifically indefensible.

BIBLIOGRAPHY

1. O'ROURKE, J. T., and MINER, L. M. S.: Dental Education in United States. Philadelphia: W. B. Saunders and Co., 1941, p. 315.

2. WHITNEY, JESSAMINE S.: Death Rates by Occupation, based on Data of U. S. Bureau of Census, 1930. New York: National Tuberculosis Association, 1934. (The professional group included lawyers, judges, justices, physicians and surgeons and technical engineers.)

3. DORN, H. F.: Death and Retirement Rate of Dentists. Unpublished report, February 1943.

4. THOMAS, R. P.: Dental Survey, J.A.D.A., 25:156, January 1938.

5. Preliminary Population Estimates, Continental U. S., January 1, 1942. Bureau of the Census, Series P-3, No. 29, September 26, 1942.

6. Reference 1, p. 341.

7. Programs for Dental Health; National Health Program Committee. American Dental Association, p. 8.

THE CALLAHAN TYPE OF PROFESSIONAL MAN AND THE NEW ERA IN HEALTH SERVICE

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IT is a distinction which I appreciate to be recorded among the recipients of the Callahan Award, because the records show that the objectives of the donors of the award have been achieved in a most creditable manner. It is a pleasure for me to come to Cincinnati for this purpose, because the profession of this city has survived the distractions of the boom period to such an extent that I can speak frankly about our past and our future without fear of offense.

The things for which Callahan stood dated farther back than his day. They were inculcated into the lives of not only the profession, but also the society with whom he came in contact, by a great character who lived in Cincinnati all through his active days. I refer to Jonathan Taft, who commuted between Cincinnati and Ann Arbor most of the period when he was dean of our dental school, and whose name was chosen to designate the title which I hold at the university. Inasmuch as the man whose name we commemorate was associated with a brother of our Taft, and there were so many similarities among the Tafts, Callahan and the leaders in the profession of this city today, I have chosen a topic for discussion which will permit me to analyze to some extent the heritage which you have, which is in need of more general restoration today.

In the light of present-day conditions, we commemorate by attaching his name to the award, not only the life of the man who was revered by the profession, but also the professional ideals of his day which he so well exemplified. Like other practitioners of his day, Dr. Callahan was imbued with a degree of humanitarianism possessed by only a minority of the profession today. Of the position which he occupied in the profession, little has been said, but this makes it especially pleasing to me to participate in the annual reminder of the life of one whose imprints upon the profession are of such significance at the present time.

Dr. Callahan represented a type of professional man about whom I wrote in 1927,[1] my contribution being editorialized in the *Dental Cosmos* of the same year. I wrote again in a similar vein in 1939[2] and 1941.[3] References were made to the loss to the specialties and those engaged in research of the leadership of operative dentistry as little less than a calamity to the profession. I deplored then as I do now the absence of the type of inspiration furnished by those who, like Callahan were primarily operative dentists. All through our early history, dentistry survived the stigma of a trade solely upon the prestige of these great characters. From the inception of the first dental college in the world until Miller's work on caries in 1889, we had little by which to justify a system of education except the conspicuous services of a few of these great operative dentists. There were no specialties, no researchers, no dental laws, few dental organizations and little literature. In fact, there was little or no profession outside the work of these men. When Black's note-

Read before the Ohio State Dental Society, Cincinnati, November 9, 1942, upon presentation of the Callahan Award for 1942.

worthy work appeared in 1895-1896, it, like Miller's, added prestige to the young profession struggling for recognition among the health sciences. Hunter's statements in 1908 about the relationship between foci of infection in the health field and systemic disease started a series of researches which have confirmed Hunter's views and brought distinction to the profession in a manner long possible but heretofore not demonstrated. Until about 1915, when dentistry was proved by these researches to be a valuable health service, the faith in it as such was based almost solely upon the work of such operative dentists in this country as Taft, Jack, Black, Guilford, McKellops, Atkinson, Peirce, Shepard, Perry, Webb, Jarvie, Dwinelle, Butler, Palmer, Westcott, Northrop, Litch, Smith, Holland, Darby, Johnson and Callahan, and, in Europe, Abbott, Brewster, Evans, Coffin and Jenkins. Take the work of these men previous to 1915 out of dentistry and we have little left.

Since 1915, dentistry has recognized the responsibility that accompanies an unquestioned position among the health service professions and has made outstanding changes in its educational system, has developed its service to conform to extensive researches and has organized as few other professions have. During these changes in the profession, efficiency, speed and specialization, so characteristic of American life today, have had a marked effect upon the service as rendered by the great general practitioners of earlier days. Research and the specialties have developed to such proportions that they are responsible to a large extent for obscuring the humanitarian service rendered by general practitioners of former days. As I wrote in 1927 and again in 1939 and 1941, the leadership of operative dentistry has practically gone, and with it much of our prestige and leadership in society. While I admire research, specialization and efficiency, I deplore the sacrifices that we have made. A critical review of our achievements as a profession reveals that we have developed the most highly efficient dental service known anywhere in the world, but that the distribution of it does not meet the requirements of society. We have been concerned, as the nation was becoming old and afflicted with many of the ills of older countries, for those who could pay for service, but we have not extended the service to those who could not pay for it, or could pay little.

As we begin the changes that are imminent, the restoration of the general practitioner to his former prestige appears as a major objective. Specialists are necessary to develop certain services to a high state of efficiency; research is necessary to increase our knowledge and to stimulate to inquiry; educators and research are necessary to the presentation of knowledge, and efficiency is a part of frugality; but the purpose of them all, as is recognized when a license to practice is issued by the public as a public health protection, is to supply a good grade of that which the public needs. The purpose of a license issued by the public is not to benefit a part of the public, but all of it. It is upon this particular feature more than any other that the great general practitioners of former days differed from too many of those of the present. They were better humanitarians, and they knew society better. If any one doubts the influence of general practitioners upon the public, let him review what took place in Michigan when a referendum was placed before the people on the matter of advertising and other undesirable professional conduct. The ones who got the most votes for the profession were those who were most beloved in their communities. The result of the referendum was a two to one victory for the state society, and the credit for success must be given in large degrees to our most humanitarian general practitioners, who could influence

the greatest number of people. If the profession succeeds in influencing public health and government officials to preserve private practice, and with it some of the world's best service, under its social security program, it will be accomplished in the same manner that success was in Michigan. It will be done only when the profession comes to a realization that its highest level is indicated by the social and professional prestige of the general practitioners of the type that we honor today.

It is with extreme reluctance that anything is said which may be interpreted as detrimental to research, because we have worked so long to get it supported financially, and are now struggling to get it in its proper place in the profession. The fact that it has not been used to any great degree to stimulate to inquiry in our schools or in the profession actuates me to say that dental research is creating some of the least humanitarian activities in society. These workers usually see little of importance except the subject in which they are interested. They do not know where they stand in society or in their own groups. If they were asked to assist in the defeat of a referendum such as we had in Michigan, or to influence state public health departments that will in the future be spending millions of dollars upon the health of the nation, they would be worth about as much as a wooden Indian in front of a cigar store.

They should study the address made by that great scientist W. D. Miller[4] at the opening exercises of the twenty-eighth session of the School of Dentistry, University of Pennsylvania, in 1905. Miller was not only a scientist, but also a great humanitarian, who forecast almost forty years ago the greatest problem confronting the present-day profession when he said,

> Another great problem with which you will have to grapple is that of making the blessings of dentistry accessible to the great masses of people.
>
> Nor does it appear to me that the development of dentistry in the last few years has been such as to make it more accessible to that class of people which in the daily struggle for existence suffers much more from the lack of sound teeth than the opulent classes who stand above this struggle or are better able to compensate for the lack of sound teeth by other means.
>
> We need materials and methods which will render it possible to shorten and cheapen dental operations so as to bring them within the reach of everyone.
>
> For we must always bear in mind that it is the object and evident duty of our, as of every other humane profession, to do the greatest possible good to the greatest possible number of people.

From these and other statements, it is obvious that Miller recognized the social responsibilities of the profession, a qualification so lacking in the profession today that some complicated problems are arising as a result of it.

Moreover, some of these followers of narrow fields of research have failed to observe that some of the greatest accomplishments of all time are the result of employment by industry of the greatest scientists and humanitarians. By the utilization of scientific knowledge for social purposes, industries have become more humanitarian in many respects than most of those in dentistry who criticize them. Probably no graduate of a school or college from our better universities knows more about society in general than the engineer. In fact, engineering, which is already an important part of public health, and the social sciences are being associated with health service education more and more each year. We are just beginning to learn that the humane professions cannot continue to exist unless they know more about the engineers who are making the world over and the people who are using this made-over world. Some of the country's most scientific men have not had access to the

Journal of Dental Research until recently because they were associated with industry.

Much the same may be said about specialists, though there would seem to be more humanitarian specialists than research workers. The desire to imitate medicine, and ignorance of the intellectual status of the scientists developing industry, have caused some of the biologic enthusiasts not only to neglect the use of other sciences, but also to deprecate the work of some of the most profound thinkers who are engaged in other scientific pursuits. Imagine, if you can, what some of these men would say if the President of the American Dental Association or the Editor of the JOURNAL were to help dedicate a new industrial plant. Yet they observe without protest the assistance of the editor of the *Journal of the American Medical Association* in dedicating some of the pharmaceutic plants which are as commercial as anything in dental industry.

The kind of research carried on by a large part of the profession today and the use that is made of it, together with the growth of specialization and the clamor for efficiency, are causing many of the teachers in our schools to ignore their humanitarian obligations to students, and too large a portion of our practitioners to do the same with their patients. It has become the style to be either a research worker or a specialist. The purpose of the schools of hygiene and medicine as given by Simon and James Thomas Flexner in their book "William Henry Welch and the Heroic Age of American Medicine"[5] should be brought to the attention of some of these persons. To be known as a humanitarian scientist like Miller, or a humanitarian practitioner like those mentioned, is in too many places regarded as old-fashioned. While Miller forecast it, Callahan was not conscious of a condition of this kind when he died in 1918. It has developed largely since his time. The year 1918 was approximately the demarcation date of a new era for dentistry. Previously, the schools of this country could not agree, for the principal reason that some were dependent on student fees for their income and would not conform to the rules of professional education. The year 1918 also marked the beginning of the development of a journal for the American Dental Association. As the schools embarked upon a program designed to meet the new obligations, the controversies between commercial and university schools became so acrimonius as to bring the Carnegie Foundation for Teaching to a realization that it owed the public a survey of dentistry similar to that which had been made in other professions.

As the survey proceeded, it became progressively obvious that commercial dental education had to go, that inquiry must be stimulated in the schools if thinking men were to be developed, that dental service would be enlarged to a great degree and that specialization would develop as it has in medicine, in proportion to the enlargement of our service. With new obligations brought to our attention and reorganization of our schools imminent, and with the development of literature with which to disseminate information, a new era was begun.

For the first time in our history, dentistry had enlisted the sympathies and assistance of the learned professions, the universities had begun to recognize their obligations to support dental education and practitioners were beginning to discard preceptor methods for scientific ones. During this period from 1915 to 1935, when the Social Security Act was passed, dentistry was developed into the broadest service of its kind in the world. This new era in dentistry paralleled in its development the advancements made in the physical world. In no other period in the world's history have we witnessed so many changes. Dentistry caught the spirit of the times and its service became

as spectacular as were many of the changes in the physical world, but the profession lost more of its humanitarianism than during any other period in its history. Business courses supported by commercial firms and a few others constituted a most damaging distraction from the problem which has been creeping up on us since the nation began to evidence an advance in civilization; viz., a service for those who cannot pay for it, or can pay but little.

We must not lose sight of the fact that dental service has previously, and during the period mentioned, been very largely a service for those who could pay for it. We have now arrived at a place where a national social security act has been accepted as necessary to the security of our people. Under this act, the profession must face a major readjustment in the distribution of its services and must find ways of furnishing service to those who can pay little or nothing for it; for health has always been considered a major factor in social security. There is a large part of the profession which does not recognize the passage of the Social Security Act in 1935 as the beginning of another new era, this time with the Federal Government fortified with authority as never before to take away former privileges of individuals, classes and states. Notwithstanding the fact that since 1935 we have witnessed greater regulation of the conduct of society, new interpretation of the constitution, reduction in states' rights, confiscation of property and the levying of taxes in increasing amounts to support the increasing numbers of unfortunate groups, procrastination has prevailed among so many of our recent leaders in responsible positions that nothing substantial has been done to correct the errors which have crept into the development of a great service, during a period of great prosperity and independence. The prosperity and independence not only of the professions, but also of society in general between the years 1915 and 1935 will never exist again. Another era is in the making.

Organizations of all kinds will be compelled to justify their existence if they have anything to do with the welfare of the people, and the sooner we begin to realize this situation, the better it will be for both the profession and the public. The organization of about every group, from barbers with small numbers to labor with millions, has divided society into thousands of units, each one existing for itself. Dental organizations have existed primarily for educational purposes and have developed the profession in an amazing fashion. Moreover, dentistry has not, on the whole, been paid too much for its service, and it has done a good work in the field of prevention. The principal criticism that can be made against the profession is that its independence from statutory obligations has caused it to leave the distribution of service for the indigent and low income groups to the large number of health organizations which have developed in most communities. Examples of a number of these will be given later. The independence of the profession in America during a period when there were plenty of people who could pay well for service, however, has resulted in the development of a service which has never existed where independence and wealth did not exist.

With independence and wealth on the decline, we must face not only government intervention in what were our former rights and privileges, but also a society demanding that we overhaul our profession in the light of its worth to all concerned, and not merely to the members of the profession. The profession in the new era which began when the Social Security Act was passed will be an integral part of society functioning for the people, rich and poor alike. I realize that many will think this statement socialistic in the extreme. It is not extreme,

however: it is merely a reflection of the many changes that are taking place as the result of a program of social security which, to be effective, requires that both individuals and organizations function in the interests of all concerned. Organizations that have functioned for their own group to the disadvantage of others will have to readjust themselves. Evidence that great changes of this kind are taking place can be obtained by studying the records of the work of the United States Supreme Court, which has been dealing largely with states rights and New Deal matters during the last two or three years. I have consummate faith that the profession would have, as fast as practicable, made adjustments which would bring the profession's service into conformity with the objectives of the Social Security Act if our recent leaders had exhibited leadership in this direction.

There are several things which could be presented in a constructive manner and which would influence both the profession and the public to unite to develop programs that would preserve the great service which we are able to render and, at the same time, prevent it from sinking to the level of that of many other countries. The profession and the public must first be informed about existing conditions. It seems safe to say that most groups of society know little about other groups. All of them may have high ideals and worthy objectives, but a high degree of achievement of these ideals and objectives often conflicts with the achievement of the ideals and objectives of other groups. When opposing groups understand one another, there is opportunity for adjustments. If they do not understand one another, they are likely to do just what a large part of the profession and the public are doing now when they designate some necessary changes which are being made as "New Deal." This is especially true in health matters. We have about everything in the shape of humanity interested, or pretending to be interested, in some form of health service, many of them unaware of what another is doing or that another is in existence.

The average person, including dentists, is usually astounded by a recitation of the present health and welfare activities of the average progressive community. A recent review of the activities of the Federal Government showed that no less than twenty departments with forty-four sections were handling some form of health activity, which, in some way, reached every state, every community and about a million farms. Under the authority of the states, we find at least twelve health services:

1. Registration of births, deaths, marriages.
2. Detection of the presence of transmissible and communicable diseases.
3. Control of epidemics by quarantine.
4. Employment of prophylactic and disinfective measures.
5. Supervision of the transportation of the sick and the dead.
6. Direction of the construction and heating of houses.
7. Protection of water supplies.
8. Health control of the different occupations of the people.
9. Protection of foodstuffs, milk, beverages and drugs from adulteration and impurities.
10. Education of physicians and dentists (public).
11. Control of garbage, streets and sewers.
12. Hospitalization of the insane, blind, feebleminded and epileptic.

There are in most progressive communities at least the following private agencies interested in health services:

1. State public health association.
2. Women's Field Army for the Control of Cancer.
3. American Social Hygiene Association, state and local branches.
4. State association for crippled children and adults.

5. Parent-teacher associations.
6. Visiting Nurses' Association.
7. Private charities, including Catholic, Jewish and Lutheran.
8. Fraternal organizations.
9. State hospital service association.
10. State tuberculosis association.

In addition to these federal, state and private health agencies, there are, in the progressive communities, from ten to thirty welfare agencies operating under a community fund and dealing with several health matters. In the little city of Ann Arbor, there are twelve, while in some other cities there are thirty or more. It would be interesting to know how many of the critics of government participation in health service know that there are between forty and fifty of these activities already in existence. Some of them perform a good service, some of them a questionable one, but all of them are stimulating a prodigious amount of writing about health matters and a health consciousness among the people. Just as there is a general lack of knowledge of the number of health activities in existence, there is unfamiliarity with the literature and the effect that it is having upon the public.

In my accumulation of about 150 books on education, society, citizenship and health, there is a marked difference in character of those written before the crash of 1929-1930 and those written since that time. This is notably true of those written since the postponement or defeat of the Wagner Health Bill of 1939. The signal to begin a crusade through the literature seems to have been the passage of the Social Security Act in 1935, but its impetus was accelerated by the defeat, or at least postponement, of the Wagner Health Bill in 1939. At that time, many thought that special appropriations were necessary to carry out the intent of the Social Security Act. Since then, we have observed new interpretations of social security and find that the government has discovered several ways to engage in health service without special legislation. As an example, we have the F.S.A., which started out to aid the farmers as regards seed, repairs, reconstruction, interest on mortgages, etc., but it was discovered that the health of the client was as important as anything else. If the borrower did not have his health, he could not pay the loan, so F.S.A. has been experimenting with the problem of health service for farmers, until all but five states have some counties involved. Present interpretations of Social Security seem to mean most anything which has a bearing upon human welfare. In fact, the National Resources Planning Board, in its report for 1942, admits that "the varied programs for Social Security assumed an unprecedented magnitude during the decade of 1930 to 1941."[6]

What has been said of the new books can be said to an even greater extent of the current magazines. A list of thirty-four of the articles appearing in the current literature since 1935 was presented at the annual meeting of our state society in April and printed in the state journal in May. Some of them are so critical and of so little constructive value that the most attention that we need give them is to note that they are discrediting the health service professions before the public. The thirty-four that I have in my collection are only a part of what has appeared which especially interested me. With between forty and fifty health and welfare activities in the average community, a large number of books and magazines agitating the subject of health and welfare, an insurance-minded public and funds for the purpose, we should expect that the Social Security Act can be broadened easily. Government approval for this purpose is likely to be given in increasing degree regardless of the war, for public opinion and precedents for action have set the stage for almost any kind of play. If the profession would give consideration to the plans of

the National Resources Planning Board, it would be clear that insurance, education, health, recreation and financial aid will receive special attention by the government under social security activities. In the 1942 report, under the heading "Welfare, Education and Health," it was stated that "the Committee is not confining its activities to planning for the post-war period but will operate on a continuing basis."[7] In this report, under "Planning for Social Security," the following appears, "Social-security planning for the post-war period must include consideration of provisions for illness and for permanent and temporary disability, compensation for wage loss resulting from these risks, and the application of the insurance principle for medical care."[8] Under "Post-War Planning for Children and Youth," the following appears, "Nevertheless, the health problems of children and youth are so well defined, the ways of meeting them so evident, and the penalties for neglecting them so heavy that the promotion of special measures to safeguard and improve the health and physical fitness of young people should have first claim upon our attention now and in the post-war period."[9] Under "Education," it is stated that "education is our largest social undertaking and offers almost unlimited possibilities for putting material resources and human abilities to work in ways that contribute to the national well-being."[10] Under "Planning for Social Security," the following appears, "Thus, broadly conceived, the objective of social security is concerned with more than the 'right to work,' or even with more than the prevention of unemployment. Its aim is to secure 'freedom from want' and this encompasses a whole complex of measures designed to provide a basic underpinning of the standard of living of the people."[11] This voluminous report for 1942 was designated by the President, as a "companion document to the budget of the United States," when he ordered it printed and distributed to members of Congress and others interested.

These are but a few of the many quotations which may be taken from the report to show that the government plans to protect health as a major part of our social security, by education, recreation, insurance and financial aid. Of these four things, education and insurance should interest the profession immediately; first, because medical insurance has already been accepted by a large section of a people already thinking of insurance, and, second, because of the strong indication that insurance for dentistry must be accompanied by education on health matters during youth or it will fail. President Dykstra, of the University of Wisconsin, told a large section of the profession at the meeting of the Chicago Dental Society in February 1939 that "health insurance was as inevitable as fire insurance," but it had little effect upon the profession except to draw adverse comment. Two years later, in August 1941, Nathan Sinai, public health authority, stated in *Harpers* that the battle for health insurance is over. He continued: "There may be some straggling rear-guard action, but to any one acquainted with the warring factions of 1935 the extent to which it is accepted in 1941 is unbelievable." Five months later, January 1942, Michael M. Davis stated, in his review of 1941, in the magazine *Medical Care*, "In the perspective of the last two decades 1941 stands out as a period when health insurance received more practical endorsement from official medical societies than at any previous time." He then named ten states in which state medical societies have put prepayment plans into operation or have plans in process of formation. He also stated that, in at least ten other states, the state societies have endorsed such plans in principle, and some have taken further action.

In the October 1942 issue of *Hospitals*, the journal of the American Hospital

Association, John R. Mannix, director of the Michigan Hospital Service, stated that there were seventy-one Blue Cross plans operating in all but nineteen states with 1,000,000 people involved. With health insurance advocated by the government and adopted by medicine, with a public already enjoying insurance for fire, life, theft, hold-up, travel, windstorm, automobile, unemployment, incapacitation, accident, old age, malpractice, etc., and with insurance companies already in the field, the profession should begin experimenting with insurance at once to obviate participation in this field by less qualified groups.

In 1930, a committee was appointed by the American Dental Association to gather data on insurance, and limited funds were provided for the purpose. Later, the American College of Dentists financed an investigation of the subject by two specialists in the field, A. M. Simons and Nathan Sinai. Among the conclusions on this study, No. 5 is especially interesting under present conditions. It is as follows: "There is practically no opposition in the medical professions of any insurance country to the principle of insurance. In spite of sharp criticisms and violent denunciations of details, the national associations of physicians and dentists have, over and over, formally approved the provision of health care to the lower-income classes through insurance."[12] Notwithstanding the warning in another place in this report that "guidance in the formation of any health program must depend upon the wisdom and intelligent leadership of the medical professions,"[13] we have not exerted the leadership necessary to preserve some of the forms of service which have disappeared under insurance in other countries. In 1938, the Chicago Dental Society published a report entitled "The Cost of Dental Care Under Health Insurance," made by Peter T. Swanish, with the assistance of members of the society. The nature of this report is well indicated in the following statement taken from the conclusions: "In the face of tremendous fiscal obstacles in the way of a plan organized to provide for the actual dental needs of men and women, it is highly probable that a health insurance plan would be forced of necessity to limit itself to providing preventive treatment only." In other words, full dental service is not insurable. *Possibly this generation is not insurable for full dental service, but this does not mean that, in a new era, with health education and service on a compulsory basis in our schools during youth, we cannot produce a people who are insurable after they leave school.* It is the belief of some countries more advanced in social security than we are that it can be done. Apparently, the profession of Canada believes it can be done, for the Canadian Dental Association presented to the Canadian government recently a plan for compulsory health insurance for all children up to age 16. There is in Congress at the present time a bill to extend the Social Security Act to include a social insurance system (H.R. 7534), a companion bill to provide for administration of state insurance plans (S. 489) and another to provide medical care for recipients of public assistance (H.R. 7411), and there is the July *Fortune* poll showing that 74.3 per cent of those consulted voted "Yes" on the question of increasing taxes to give medical care for all after the war.

One of two things seems imminent: dentistry must engage in health insurance, wholly or partially, or show better than has been shown to date that it cannot be done. Another phase of the health service problem which should have immediate consideration in the new era is the qualifications of dentists. Organized dentistry has done a prodigious amount of educational work to develop the profession to its present scope and standards of service, but it has not been in a position to compel equality in ability; for at

least one-third of the profession is unable to render service which will bear the scrutiny of public health administrators. We have the lesson of the rejectees and the results of examinations by foundations, school authorities and others, to show that many of those outside organized dentistry, and unfortunately a few within it, have not adapted their practices to conform to public health standards. With the extension of health service under the guidance of public health administrators, with the authority of county, municipal and state health departments, utilizing funds from the national government, this condition must change, or the foundation of the Social Security Act as it relates to health will fail. We cannot have a large percentage of the profession doing a large amount of work below public health standards. We have set standards for admission to practice, but have left the matter of keeping up new developments to each individual. Just as it has experimented with health insurance, medicine has begun experimenting with this subject on an extensive basis. The educational number of the *Journal of the American Medical Association* for 1942 reported that thirty-nine states were giving some form of continuation study for practicing physicians. State societies, local societies, medical schools, state health departments and hospitals were involved in these programs to change the situation in medicine, which is analogous to the one in dentistry.

Reference has been made to public health administrators, but little has been said about the position that they will occupy in health programs of the future. Like the great movements in insurance and postgraduate work, the developments in public health have escaped the attention of the leaders of the American Dental Association during recent years. We have had justification in many instances for placing low estimates upon the work of those who were designated as public health workers. They have often been rated as little better than welfare workers in their knowledge of health matters. This is a situation similar to the one that existed when dentistry was no older than the public health profession.

The first school of what was then designated as hygiene was organized at Johns Hopkins University in 1916 with funds furnished by Rockefeller Foundation, under the guidance of that great humanitarian William Welch. Since that time, the profession of public health has been developing into what is now regarded as a necessary leader in health service. As the nation has become an aggregation of groups and specialists unfamiliar with one another's activities, the health services have done likewise, until the government is confronted with the matter of administration as much as it is that of funds. There is little chance for the government to succeed in extension of the health service aspects of the Social Security Act until it finds out who is who among the large number of health and welfare workers, who are confusing the public as well as the government. We have some indications of what is to take place to remedy the situation. In the September 1940 issue of the *American Journal of Public Health,* under the title "Health Department as a Leader for All Community Health Work," it is stated that a "comprehensive and well coordinated public health program in any local community or state can exist only when the health department assumes the leadership in public health administration." Obviously, the American Public Health Association claims leadership in health matters. The fact that the government gave priorities for the construction of the new Rockefeller-Kellogg School of Public Health during the war is evidence that the government agrees with the American Public Health Asssociation. There are many other evidences that the professions will have to deal with public health administrators whose point of view is health for all. This is going to require a readjustment of the profession's idea of service. We

must henceforth join with these public health administrators to find ways to furnish service for those who can pay little or nothing for it. When this is done, the ones who are most affected, and will have the burden of influencing government and public health officials toward saving the things of which American dentistry is most proud, will be the general practitioners. If we have enough of the type that we commemorate today, who were beloved by the people of their communities, we shall succeed, provided we can get a leadership that has a background of knowledge in matters pertaining to social security.

Any program that is contemplated must be based not only upon a knowledge of social security matters, but also upon a sincere conviction of the application to dentistry of the statement of that eminent historian Henry E. Sigerist, in his book on "Medicine and Human Welfare," that "private competitive medicine cannot satisfy the needs of a nation." Something must be added to it. It is not necessary to destroy what we have, but if we procrastinate until unqualified persons or groups take the lead in making the additions to our service, we shall probably have results not in the interest of either the profession or the public.

A second conviction must be held by our leaders when adding to our service; viz., that voluntary qualifications of dentists after the receipt of a license to practice permit too large a number of unqualified practitioners.

If we find ways to cooperate with the government to extend our service to indigent and low-income groups, and if we insist that all dentists render service that meets public health standards, we shall be in a strong position to demand the preservation of private practice and those excellent services which are rendered in the good private practices today. There are many evidences that government and public health authorities will cooperate to preserve private practice if we proceed to modify our service to conform to present needs. The fear held by many of the profession that a regimented system of service will accompany the extension of the Social Security Act seems to have little basis for existence. Virtually every activity of the government in the field of dentistry has been conducted through recognized channels of service such as dental societies and state health departments, notwithstanding the annoying socialistic regimentation displayed by some government officials in other fields. In the National Resources Planning Board report for 1942, under the heading "After Victory—What?" the following appears: "We must plan to decentralize post-emergency activities as far as possible; to use to the utmost our system of modified free enterprise with its voluntary equipment, its special reward for effort, imagination, and improvements, its elasticity and competition; and to advance cooperatively under national and governmental leadership."[14] This does not suggest regimentation. On the contrary, it commits the planning board to the principle of free enterprise with reward for merit. This is the very philosophy of American dentistry's great service. We have had free enterprise in dentistry during a period of great prosperity, with good rewards for service. As we now undertake our greatest task of the new era of making our service available to all mankind, as Miller advocated in 1905, we should utilize all available assistance to preserve private practice, and then restore in it to the fullest extent the ideals which we commemorate and the characters who exemplified them.

BIBLIOGRAPHY

1. WARD, M. L.: Comparative Usefulness of Amalgam and Other Materials for Filling Teeth. *D. Cosmos*, 69:785-796, August 1927 (p. 788).

2. Idem: Our Scientific Development and Increasing Obligations. *New York D. Soc. Bull.*, 8:1-8, July-August 1941 (p. 8).

3. Idem: Need for Cooperation of Public,

Health Service Professions and Government. J.A.D.A., 26:1441-1450, September 1939 (p. 1446).

4. MILLER, W. D.: Inaugural Address. *Pennsylvania D. J.*, 9:16-26, November 1905.

5. FLEXNER, SIMON, and FLEXNER, J. T.: William Henry Welch and Heroic Age of American Medicine. New York: Viking Press, 1941, p. 360.

6. National Resources Planning Board. National Resources Development Report for 1942. Washington: Government Printing Office, 1942. Pt. 3 (8) Planning for Social Security, p. 109.

7. *Ibid.*: Pt. 1 (2) After Victory—What? p. 43.

8. *Ibid.*: Pt. 3 (8) Planning for Social Security, p. 112.

9. *Ibid.*: Pt. 3 (9) Post-War Planning for Children and Youth, p. 117.

10. *Ibid.*: Pt. 3 (9) Post-War Planning for Children and Youth, p. 120.

11. *Ibid.*: Pt. 3 (8) Planning for Social Security, p. 109.

12. SIMONS, A. M., and SINAI, NATHAN: Way of Health Insurance. University of Chicago Press, 1932, p. 205.

13. *Ibid.*, p. 204.

14. National Resources Planning Board. National Resources Development Report for 1942. Washington: Government Printing Office, 1942. Pt. 1 (2) After Victory—What? P. 9.

INDIVIDUAL SUSCEPTIBILITY TO DENTAL CARIES

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EXTENSIVE research in the fields of histogenesis, histology, calcification, bacteriology and biochemistry and comparative animal, field and clinical studies have made valuable contributions to our knowledge of the predisposing and exciting causes of dental caries. Failure to solve the problem may be due to lack of coordination in interpreting these findings and filling in any gaps that may exist.

This work was undertaken under conditions of private practice that precluded the possibility of using the usual statistical methods, because of lack of time and clinical material. The method adopted, therefore, was one in which chemical changes in my own saliva were produced by changes in diet and quantitative determinations were made of these changes. Extracted teeth were then subjected to saliva altered in accordance with the changes that were produced by the varying diets.

Miller's[1] bacteriochemical theory has found almost universal acceptance. In simple experiments, he showed that there existed in the saliva a substance capable of forming lactic acid from carbohydrates, and that boiling and the use of antiseptics prevented the acid formation. He assumed that the substance was due to the presence of bacteria. Numerous other investigators[2, 3] have stated that aciduric and acidogenic bacteria are always present in the oral cavity.

Miller's carbohydrate food impaction theory[1] does not account for individual susceptibility. Many filthy mouths, having no prophylactic care whatever, show immunity to caries; while many scrupulously clean mouths, receiving excellent care, show rampant caries. Rosebury[4] says:

> In view of what has been said it may appear paradoxical that a mitigating or retarding effect on caries can be exerted by certain dietary conditions; but the fact remains true. The inference regarding this effect, furthermore, is that it is constitutional or metabolic rather than direct or environmental; but its mechanism has not been satisfactorily explained.

We do have in the oral cavity all of the conditions necessary for the conversion of the polysaccharides into fermentable sugars and finally into acids: the presence of amylolytic enzymes and aciduric and acidogenic bacteria, together with proper temperature, moisture, etc.

As the first manifestation of caries is on the surface of the enamel, this discussion will be confined to caries of enamel.

In its mineral phase, enamel is composed principally of hydroxyapatite and calcium carbonate. Hydroxyapatite is a hydrated tricalcium phosphate, the percentage ratio of tribasic calcium phosphate to calcium carbonate being, according to Brekhus and Armstrong,[5] 12.60; while that of dentin is 7.41. The calcium carbonate is regarded by some as a contamination.[6] My report, soon to be published, may throw additional light on this subject.

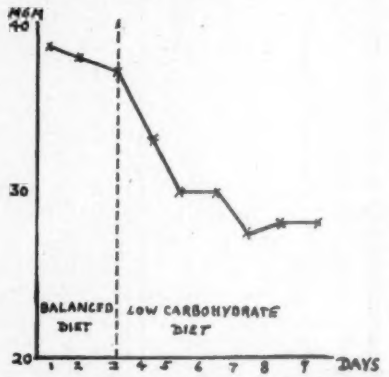

Fig. 1.—Carbohydrate content in milligrams of glucose per hundred cubic centimeters of saliva.

While my recent unpublished work would seem to indicate an increasing importance of proteolysis in the final stages of cavity formation of the enamel, the solubility of the calcium carbonate and hydroxyapatite is of primary importance in the decalcifying process.

Forbes[7] explains the solubility of enamel as follows:

$$\underset{\text{Solid}}{Ca_3(PO_4)_2} \rightleftarrows \underset{\text{Solution}}{Ca_3(PO_4)_2} \rightleftarrows \underset{\text{ions}}{3Ca^{++}+2PO_4^{---}}$$

$$(Ca^{++})^3 \times (PO_4^{---})^2 = K$$

in which K is an ionization constant.

Forbes[7] says further:

> Since the enamel is primarily composed of inorganic salts we must assume that its solution follows the same lines as that of any other insoluble inorganic salt. Also, since the enamel is primarily composed of calcium and phosphates, we may assume for this discussion that it consists mainly of $Ca_3(PO_4)_2$, feeling that what holds true for this salt must hold true, with limitations, for the substance of which enamel is composed. We have seen that the solution of $Ca_3(PO_4)_2$ is dependent on the concentration of the Ca and PO_4 ions. If the product $(Ca^{++})^3 \times (PO_4^{---})^2$ is momentarily increased over the value K (ionization constant) deposition or precipitation of $Ca_3(PO_4)_2$ takes place; but if the product is reduced below K, solution of the $Ca_3(PO_4)_2$ proceeds until the product is again increased to K. It would therefore seem that those factors which influence the concentration of the Ca and PO_4 ions, in the saliva bathing the teeth in any particular locality, must be determining factors in the etiology of caries.
>
> The chief factors involved in determining the PO_4-ion concentration of the solution bathing the teeth in any locality are likely to be (a) the phosphate concentration and (b) the H-ion concentration of the solution in that locality. The influence of the former is evident and requires no further comment, but a discussion of the latter may be in order. It was shown when considering the solution of $Ca_3(PO_4)_2$ in acids that the first step in the reaction was a reduction of PO_4-ion concentration through a combination of the PO_4 ions with the H ions to form HPO_4 ions. . . . For example, if the H-ion concentration is increased by the addition of acid, some of the H ions combine with the PO_4 ions and a corresponding decrease in the concentration of the PO_4 ions ensues . . . which by the further addition of acid may be changed into the soluble $Ca(H_2PO_4)_2$.

While some question exists as to an exact solubility product constant for

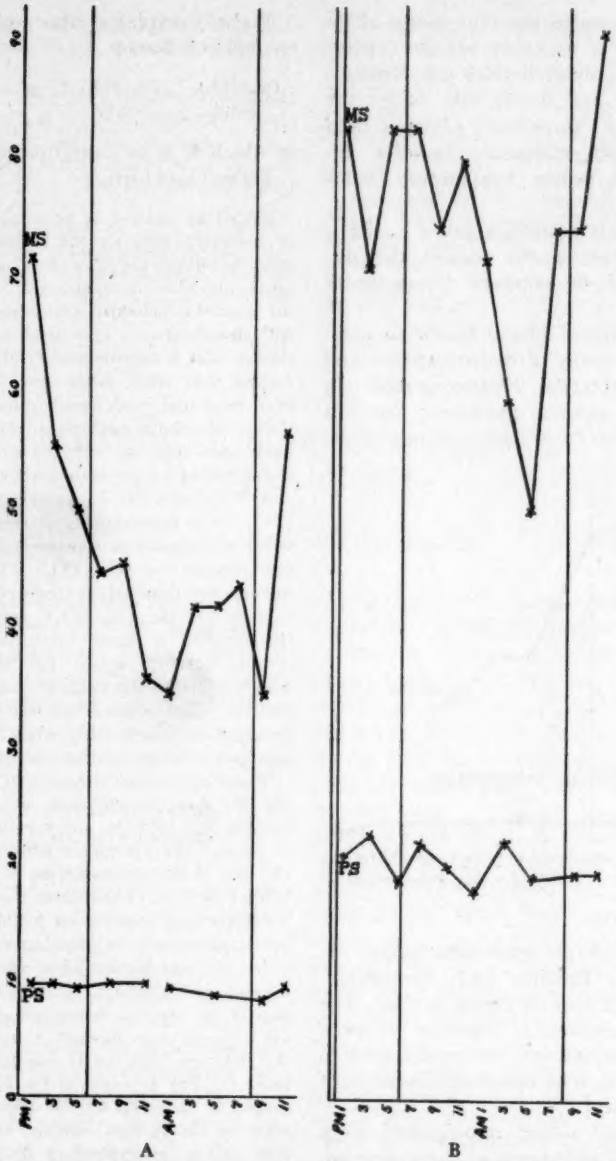

Fig. 2.—Carbohydrate content in terms of milligrams of glucose per hundred cubic centimeters of saliva. A, low carbohydrate diet. B, high carbohydrate diet. PS, parotid saliva. MS, mandibular saliva.

tribasic calcium phosphate, there seems to be no doubt that the solubility increases with increased H-ion concentration and that an accumulation of calcium and phosphate ions retards and finally stops its solution.

All fresh saliva within the normal ranges of pH is saturated or supersaturated with tribasic calcium phosphate. Fosdick, Hansen and Epple[3] state that "from these results, it can be said that all human saliva is saturated or supersaturated with calcium phosphate." Enright, Friesell and Trescher[9] say:

> All these results indicate not only a state of saturation but one of supersaturation. If this is true, if the saliva is supersaturated with tricalcium phosphate, why is there not a precipitation of the salt in excess of that required for saturation? All through their papers these workers show that the precipitation of tertiary calcium phosphate is a slow process.

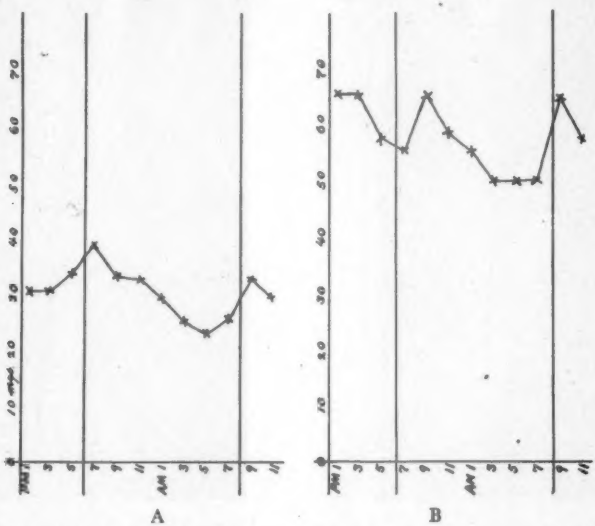

Fig. 3.—Carbohydrate content, whole saliva. A, low carbohydrate diet. B, high carbohydrate diet.

It would seem from the foregoing that the tribasic calcium phosphate of the saliva being in equilibrium with that of the enamel, the hydroxyapatite is thoroughly protected against dissolution within the normal range of pH of the saliva.

The problem of dental caries would, therefore, seem to be one of accounting for a sufficient increase of H-ion concentration in a localized area to reduce the calcium and phosphate ion product below the value K in that area regardless of the higher pH of the surrounding liquid with which it is in contact.

Upon the theory that potential H-ions existed in the mucin of the saliva, tests were made with Benedict's qualitative alkaline copper solution for a reducing sugar in mucin, which is a glycoprotein; with negative results. However, after hydrolyzation with hydrochloric acid, a positive reaction was obtained, as was to be expected. Quantitative determinations[10] of the amount of sugar in my saliva varied to such an extent that no consistent results could be obtained, and it became evident that the cause or causes of the inconsistencies must, if possible, be determined and eliminated. These inconsistencies might be the result of a number of conditions including diet, ingestion of drugs, mastication, nerve stimulation, emotion, smoking, variation in the activity of the three sets

of salivary glands and the changes in composition or amount which take place during twenty-four hours.

In normal individuals, mastication greatly increases the flow of saliva, but the effect of chewing on the secretions from the individual sets of glands has never been determined, to my knowledge, either qualitatively or quantitatively. The chemical and the physical properties of the secretions from the sublingual and submaxillary glands, which I have termed the mandibular saliva, are quite different from that of the parotid glands. It can be readily appreciated that an unequal response to stimulation by the two sets of glands would alter the chemical and physical characteristics of the whole saliva. Of the above-mentioned conditions influencing the composition of the saliva, all can be readily eliminated or controlled except variation in the quantities of saliva secreted by the two sets of glands, and a method had to be devised to separate the parotid from the mandibular saliva.

An appliance was constructed[11] that made it possible to collect the parotid and mandibular saliva simultaneously in separate containers. By the use of the saliva separator and by controlling the conditions influencing the amounts and composition of the saliva, it was possible to obtain uniform results.

Fig. 4.—Line indicating area on labial surface of mandibular incisor exposed to saliva-dextrose-tricalcium phosphate solution for five months and ten days; showing decalcification and remineralization of enamel. (Unstained.) A higher magnification of the circular area is shown in Figure 6.

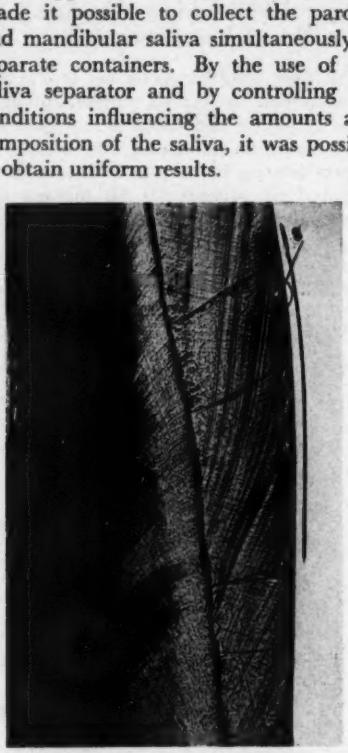

Fig. 5.—Same as Figure 4; surface exposed to the saliva-dextrose-tricalcium phosphate solution for ten months. (Unstained.) A higher magnification of the circular area is shown in Figure 7.

Quantitative determinations of the amounts of carbohydrate in my saliva every two hours over a twenty-four hour period on the high and low carbohydrate diets were made on the parotid and mandibular saliva, being repeated several times, with consistent results.[12]

Figure 1 shows the changes in carbohydrate concentration of the whole, unstimulated saliva during the change from

my usual restricted carbohydrate diet (first three days) to a very low carbohydrate diet. Figure 2 shows the carbohydrate concentration of the parotid and mandibular saliva over a twenty-four hour period on the contrasting diets. Figure 3 shows the carbohydrate concentration of the whole, unstimulated saliva over a twenty-four hour period on the contrasting diets. During these and subsequently described experiments, occasional controls, using the saliva of others, were examined to show that there was nothing unusual about my saliva, and semiannual physical checkup showed excellent health.

Fig. 6.—Higher magnification of circular area in Figure 4.

Fig. 7.—Higher magnification of area marked 8 in Figure 5, showing decalcification and remineralization of intercolumnar substance.

While quantitative determinations of the amount of carbohydrate in my saliva, by acid hydrolysis, on the contrasting diets were interesting, they did not show how fermentable sugar was formed in the stagnant saliva. The possibility that amylolytic enzymes in the stagnant saliva might hydrolyze the complex carbohydrate into a fermentable sugar, which could be demonstrated by preventing fermentation, was tested by adding thymol to the saliva and incubating at 37°C. for varying lengths of time. Benedict's test showed the presence of a reducing sugar.[12] Tests showed the saliva-thymol solution to be sterile in less than fifteen minutes after the thymol was added, indicating that hydrolysis of the complex carbohydrate was not the result of the action of bacterial enzymes.[12]

While reducing substances other than sugar may exist in the saliva, or incubated saliva, in small amounts, if aliquot portions of a specimen of saliva are tested by adding thymol to a and nothing to b and testing c immediately, it will be found that there is very slight, if any, reduction of copper in the immediate test (c). After incubation of a and b, the saliva containing thymol (a) will show marked reduction of copper, due to the presence of a reducing sugar;

while b will show little or no reduction, owing to fermentation of the sugar as formed. If whole saliva, collected as described in a previous report,[12] is divided into two equal parts, one of which is heated to 75°C. and maintained there for ten minutes to prevent hydrolysis, and is kept at a temperature of 7°C. for forty-eight hours, or longer, the heated portion will give a negative response to Benedict's test, while the unheated one will give a positive reaction.

The formation of acids from incubated, unfiltered saliva has been corroborated by Simmons.[13]

While the maximum sugar content of 66 mg. in my unstimulated, whole saliva on the high carbohydrate diet is

Fig. 8.—Completely impacted cuspid, rectangular area (white) exposed to saliva containing 1 per cent dextrose and ten molar teeth with only sound enamel exposed, for eighty-five days. The saliva-dextrose solution was renewed daily. The minimum pH was 4.2, with no increase in pH.

inadequate to produce any marked change in the H-ion concentration of the buffered saliva, tests have shown that about 60 per cent of this sugar will be found in the gelatinous mucin precipitate formed from the whole saliva standing for one hour at room temperature, or the mucin precipitate will have a sugar concentration of 1.1 per cent.

For further evidence of the potential acidity and impermeability of spontaneously precipitated salivary mucin,[14] 50 cc. of partly stimulated saliva was collected at 0°C. in a flask containing 2 mg. of bromcresol purple and agitated frequently. The solution was then divided into two equal portions, one of which was placed in a 50-cc. conical centrifuge tube, to the sides of which thymol crystals had been fused to prevent fermentation and the tube marked A. The other half of the saliva-bromcresol purple solution was placed in a similar tube, without thymol, and marked B. Both tubes were then placed in the incubator at 37°C.

Fig. 9.—One section made through cavity and another section made through white area of tooth shown in Figure 8. The smaller break in the surface is an artefact.

The supernatant liquid in both tubes and the spontaneously precipitated mucin in tube A remained purple throughout the experiment. The precipitate in tube B changed from purple to light yellow in eight hours, thus indicating a pH of about 5.4. The contrast of color in the precipitate in B lasted for about sixteen hours after the maximum was reached. On the Beckman meter, pH determinations with the glass electrode of the precipitate and supernatant liquid (separation without contamination being

only partially successful) showed the supernatant liquid to be pH 7.02 and the precipitate pH 6.42 twenty-two hours after being placed in the incubator, the original pH of the whole saliva being 7.20.

The method of localization of the mucin precipitate in specific areas may be explained as follows[15]: Spontaneous precipitation of mucin in saliva is probably due to enzymic activity, and is a gradual process. If 100 cc. of stimulated saliva is collected at 0° C. in a 100-cc. beaker and allowed to stand at room temperature, it will be observed that the

Fig. 10.—Completely impacted incisor with small area exposed to saliva containing 0.4 per cent dextrose, renewed daily for eighty-five days. The minimum pH (4.2) was attained in about six or seven hours, then increased to a maximum of pH 6.0 in the twenty-four hour incubation period.

mucin starts to separate, the lower portion of the liquid becoming less transparent and the supernatant liquid more transparent. In about one hour after the saliva is collected, the mucin precipitate has settled to the bottom of the beaker, its volume now being about 5 to 7 cc. If allowed to stand indefinitely, the precipitating mucin gradually decreases in volume, becoming more flocculent, with a decrease in viscosity, and resembles the creamy deposits frequently found at gingival margins and interproximal spaces when prophylaxis has been neglected.

When partial precipitation of the mucin has taken place, after it has stood about one hour, if the beaker is held up to the light and rotated a short distance to the right, then to the left, it will be seen that the fluffy precipitate adheres to the bottom and sides of the beaker. If the saliva is gently rotated with a glass rod, the mucin precipitate becomes more concentrated and is condensed to about 1.5 cc. It is a creamy white and very adhesive and assumes a globular form in the center of the beaker. If a rough or irregular spot exists in the bottom of the beaker, the mucin precipitate will adhere to that spot. After the saliva has been rotated, most of the supernatant liquid can be decanted off, the remainder being composed of mucin, some of the supernatant liquid, epithelial cells, bacteria, etc.

It has been shown in a previous report[12] that a concentration of 1.1 per cent of fermentable sugar could be attained in the mucin precipitate obtained as described above, from 100 cc. of my saliva on a high carbohydrate diet.

These phenomena would seem to offer an explanation of the method of localization of enamel decalcification within certain specific areas of the enamel. Each night, during the sleeping period, the concentrated saliva is slowly discharged from the salivary glands into the oral cavity. The upper and lower arches being in contact, or nearly so, the saliva flows around the teeth, being confined to those areas by the tongue, cheeks and lips. Precipitation of the mucin takes place, it adhering to any roughened or irregular area. During sleep, all muscular movements of the lips, tongue and

cheeks cease except occasional involuntary swallowing.

If we study the act of deglutition without food in the mouth, we will find that the teeth are brought together and the tongue flattened in the floor of the mouth to displace the saliva laterally and forward to the tip of the tongue. The tip of the tongue is carried forward, displacing the saliva upward. Successive portions of the tongue are then elevated, forcing the saliva backward. These muscular movements of the tongue prevent the accumulation of the mucin precipitate on the lingual surfaces of the posterior and lower anterior teeth for any length of time, and we rarely find decalcification in these areas if the surfaces of the teeth are smooth.

The first movements of the tongue in swallowing force some of the saliva through the interproximal spaces, when open, and between the occluding surfaces of the upper and lower arches, further movement being retarded by the cheeks and lips. These salivary currents cause the precipitated mucin to condense and concentrate in any roughened or irregular areas, such as pits, fissures, contact points and gingival crevices. The precipitated mucin then undergoes hydrolysis and fermentation with the formation of acids.[12] The time required is probably influenced by many factors, but it has been shown that it can occur *in vitro* in from three to four hours.

If the isoelectric point[15] of the condensed adherent mucin precipitate is reached, owing to hydrolysis and fermentation of the carbohydrate radical, more mucin is precipitated at that point. This new deposit undergoes the same process as the original one, but is hastened by the greater H-ion concentration, which facilitates hydrolysis and the proliferation of certain types of acidogenic bacteria, the acidity being greatest on the surface of the enamel and decreasing toward the surface of the plaque. The whole process thus becomes self-perpetuating, and the vicious cycle continues until disturbed by mastication or prophylaxis. In protected areas, as in actual cavities, interproximal spaces, pits and fissures, if prophylaxis is neglected, the process may become continuous. Carbohydrate food impaction may have the same result, or carbohydrate food particles may start the vicious cycle. Carbohydrate food impaction is not necessary for the production of dental caries, but is no doubt an important factor in defects of pits and fissures.

Thus, an alternative is presented to Miller's food impaction theory whereby the gelatinous mucin precipitate, containing potential H-ions in the form of a complex carbohydrate, is localized in the specific areas of enamel which have been found by clinical experience to be particularly susceptible to decalcification. The carbohydrate radical of the mucin then undergoes hydrolysis and fermentation to form acids, the concentration of the carbohydrates in mucin being influenced by the amount (or type) of carbohydrate in the diet.

The degree of supersaturation of the saliva with tribasic calcium phosphate, as well as the concentration of the carbohydrate, influenced by other factors, such as abrasion (brush or mastication), determine the type, degree and rapidity of enamel decalcification. Probably the most important single factor in immunity or susceptibility to caries is the ratio of the potential H-ion concentration to the potential calcium and phosphate ion concentration in the precipitated mucin in a localized area; and of almost equal importance is the ratio of tribasic calcium phosphate to calcium carbonate and their distribution in the enamel.

DECALCIFICATION EXPERIMENTS

To apply this theory to extracted teeth, 1 per cent dextrose was added to my saliva, together with an excess of commercial tribasic calcium phosphate, and a number of teeth, coated with nitrocellulose, with small areas of enamel exposed, were placed in the solution, which

was incubated at 37°C., until all the sugar was fermented, when the solution was renewed, the minimum pH being 4.4. After varying lengths of time, the teeth were removed and sectioned and examined unstained under the microscope.

During the incubation period, it was observed that considerable gas was formed, but if no teeth were placed in the solution, after a few hours no gas was formed. Controlled tests showed that this gas was carbon dioxide.[16] Histologic examination seemed to indicate that the calcium carbonate was removed from the interprismatic substance of the enamel, and although the pH attained in the fermenting solution was 4.4, the enamel was not dissolved away, the surface remaining intact.

My interpretation of these phenomena was that the first step in enamel decalcification was dissolution of the calcium carbonate of the interprismatic substance, rendering the enamel porous. This not only furnished additional calcium ions, raising the ion product above the value K, but would increase the pH in a localized area, both of which would cause a deposition of tribasic calcium phosphate in the enamel. Calcium carbonate is soluble below pH 7.7.[15] Thus, we would have in a medium containing potential H-ions and adequate potential calcium and phosphate ions, the necessary factors for replacing the calcium carbonate with tribasic calcium phosphate. This may account for the so-called sclerosis, aging or maturing of enamel after the tooth is erupted, and while such enamel is more resistant to the action of acids, it is less resistant to abrasion (brush or mastication).[15] Dissolution of the calcium carbonate from the interprismatic substance of enamel, placed in an aqueous solution of lactic acid saturated with tribasic calcium phosphate above pH 5.2, is strongly indicated in my work soon to be published.

As the saliva rarely attains a degree of alkalinity of pH 7.7, it is probable that some slight superficial dissolution of the calcium carbonate from the interprismatic substance is constantly occurring. Remineralization with tribasic calcium phosphate may occur, retarding or stopping its progress; but the area has been rendered less resistant to mechanical abrasion and, as the remineralized area is worn away, by brush or mastication, decalcification and remineralization are resumed. The process may be very slow, extending over a long period of years; which may account for the gradual disintegration of the enamel with advancing years and penetrating stains, mechanical abrasion (brush or mastication), erosion, cracks, increasing friability and senile caries.

Figures 4 and 5 are photomicrographs of incisor teeth which were exposed to the saliva-dextrose-tricalcium phosphate solution for five and ten months, respectively, the line near the surface indicating the exposed area. The surface being intact, areas of higher magnification, shown in Figures 6 and 7 (corresponding to areas marked 7 and 8, respectively, in Figures 4 and 5), were interpreted to evidence remineralization of the interprismatic substance. Although the tooth shown in Figure 5 was exposed to the solution twice as long as that in Figure 4, its reaction to the solution was not nearly so marked as in Figure 4, showing a marked difference in calcification.[16]

After the publication of this work questions arose as to the use of commercial tribasic calcium phosphate and the use of teeth which had been in contact with saliva for unknown periods. Accordingly, the experiments were repeated, using completely impacted teeth coated with paraffin wax, with small areas exposed. The tooth shown in Figure 8, a completely impacted cuspid, was placed in a solution of saliva containing 1 per cent dextrose which had been incubated until a pH of 5.0 was attained. Ten molar teeth, with only sound enamel exposed, were also placed in the saliva-dextrose solution, and the procedure

repeated the following day when all the sugar was fermented. The minimum pH was 4.2. With this method, the experimental teeth were in a solution in which the H-ion concentration was constantly increasing, or remaining at its maximum concentration, and no remineralization would occur. The condition was intended to simulate active caries.

The exposed area of the tooth shown in Figure 8 rapidly turned white, but the surface remained intact for eighty-five days, when the small cavity suddenly appeared at one end of the white area. Two sections were then made, one through the cavity and one through the white area where the surface continuity had remained intact. (Fig. 9.) During grinding, a small piece was broken from the section showing the white area with surface intact. When this type of decalcification has penetrated deeply into the enamel, sectioning without loss of the decalcified area is very difficult.

The second method adopted with the completely impacted teeth attempted to reproduce conditions that theoretically would cause decalcification with remineralization. The teeth were prepared in the same manner. With both methods, the enamel was thoroughly cleansed and the cuticle removed before coating with wax. Four-tenths per cent dextrose was added to my saliva, and the teeth were put in the solution, which was placed in the incubator at 37°C. Under these conditions, the solution attained a pH of 4.2 (as with the first method) in about six or seven hours, after which it increased to a maximum of pH 6.0 the following day, when this procedure was repeated. At the end of eighty-five days (as with the first method), the tooth was sectioned. (Fig. 10.) With this type of decalcification, sectioning is more successful.

As this work is, as yet, unfinished, I shall attempt no description of the zones produced by the two methods, but it is evident that differences do exist. These zones correspond in histologic appearance with the zones found in incipient caries produced *in vivo*.

If we view the penetrated surface of the enamel as a thickening porous membrane, containing tribasic calcium phosphate which dissolves or is deposited with changes in hydrogen, calcium and PO_4-ion concentration, on one side of which we have a basic salt (calcium carbonate) soluble at pH 7.7, and, on the other side, acid formation in a medium originally saturated with calcium and phosphate-ions, some idea of the complicated reactions taking place in the various layers of the area can be formed, and one wonders if an accurate interpretation is possible. The results of grenz-ray, or x-ray diffraction, electron microscope or micropolariscopic examination, when compared with accurate records of the method used to produce the various types of decalcification, might be revealing.

The difference in appearance of the two groups of specimens, one using the commercial tricalcium phosphate and the other using the solid enamel, is probably due to the form in which the trabasic calcium phosphate exists. The dextrose in both solutions was dissolved and therefore evenly dispersed through the saliva, thus facilitating rapid and uniform fermentation. The commercial tribasic calcium phosphate was in powdered form, a large amount of surface to the saliva being exposed, and was in close contact with the exposed areas of the teeth. The pH did not go below 4.4. In the second group, the tribasic calcium phosphate was in the form of solid enamel, with a relatively small surface exposed, which, in a colloidal solution, such as saliva, would retard ionic interchange, the minimum pH being 4.2.

The sudden appearance of the cavity shown in Figure 8, without previous dissolution of the surface, would strongly suggest that proteolysis is a factor in cavity formation in protected areas of enamel. This is further indicated by an x-ray picture taken of a cavity, produced

in vitro, where a dislodged fragment of enamel can be seen in the cavity. Although I have dwelt at some length on the dissolution of hydroxyapatite in connection with enamel caries, as my work progresses considerable doubt arises in my mind as to the importance of this factor. It seems quite possible that, upon dissolution of the calcium carbonate, the undissolved tribasic calcium phosphate is held *in situ* by the delicate organic stroma, unless worn away by external friction, final liberation of the undissolved calcium phosphate being due to proteolysis of the organic stroma.

It is not always possible to correlate caries with the presence of excessive (or refined) carbohydrates in the diet. Disturbances of insulin metabolism, involving the salivary glands, may be a factor.[17] Birnkrant[18] reports "some clinical evidence to support parotid-pancreas relationship." He quotes various authorities who have found a correlation between bilateral hypertrophy of the parotid glands and diabetes, one theory being that this hypertrophy is a compensatory mechanism; "i.e., the parotid glands take on the function of the pancreas in some instances of hypo-insulinism." Others attribute it to the secretion of an anti-insulin parotid hormone. The amount of insulin secreted is influenced by the amount of carbohydrate absorbed.[17] Any disturbance of this mechanism might alter the normal response of the islands of Langerhans and the salivary glands to the diet and might be factors in our failure to consistently correlate caries with the diet.

SUMMARY

Miller's food impaction theory fails to explain individual susceptibility to caries and also fails to explain how the various types of enamel decalcification are produced.

The chemical changes produced in the saliva by changes in diet, when not perverted by abnormal endocrine activity, offer a more plausible explanation.

Salivary currents, during sleep, and the physical characteristics of the spontaneously precipitated mucin in the stagnant saliva, play an important rôle in localizing the acid formed by hydrolysis and fermentation of the carbohydrate radical in mucin, to specific areas of the enamel which have been found by clinical experience to be particularly susceptible to enamel decalcification.

BIBLIOGRAPHY

1. MILLER, W. D.: Micro-Organisms of Human Mouth. Philadelphia: S. S. White Co., 1890.

2. SNYDER, M. L.: *J. D. Res.,* 18:508, December 1939.

3. FOSDICK, L. S.; HANSEN, H. L., and EPPLE, CHARLOTTE: Enamel Decalcification by Mouth Organisms and Dental Caries: Suggested Test for Caries Susceptibility. J.A.D.A., 24:1275, August 1937.

4. ROSEBURY, THEODOR: Dental Science and Dental Art. (Samuel M. Gordon, editor.) Philadelphia: Lea & Febiger, 1938.

5. BREKHUS, P. J., and ARMSTRONG, W. D.: *J. Biol. Chem.,* 120:677, September 1937.

6. KLEMENT, R., and TROMEL, G.: *Ztschr. f. physiol. Chem.,* 213:263, 1932.

7. FORBES, J. C.: *J. D. Res.,* 11:591, August 1931.

8. BENEDICT, H. C., and KANTHAK, F. F.: *J. D. Res.,* 12:277, April 1932.

9. ENRIGHT, J. J.; FRIESELL, H. E., and TRESCHER, M. O.: *J. D. Res.,* 12:759, October 1932.

10. GORE, J. T.: *D. Cosmos,* 77:942, October 1935.

11. *Idem: J. D. Res.,* 17:69, February 1938.

12. *Idem: Ibid.,* 17:411, October 1938.

13. SIMMONS, N. S.: *J. D. Res.,* 20:255, June 1941.

14. GORE, J. T.: *J. D. Res.,* 21:383, August 1942.

15. *Idem: Ibid.,* 19:563, December 1940.

16. *Idem: Ibid.,* 19:455, October 1940.

17. *Idem: Ibid.,* 20:107, April 1941.

18. BIRNKRANT, W. B.: *J. Lab. & Clin. Med.,* 27:510, January 1942.

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FUNCTIONAL OCCLUSION FOR ARTIFICIAL DENTURES

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THE development of an occlusal design for artificial dentures that meets the requirements of a patient for comfort and efficient function remains a debatable problem after many years of intensive study and research. Certain fundamental principles are universally accepted and agreed on, but technics still vary greatly, depending on the approach to this perplexing problem.

With my technic, the principle of functional occlusion, developed by a maxillary center bearing point, functioning in a 30 degree vertical dimension device, secured on a horizontal plane, and mounted on a mandibular baseplate, has proved, after ten years of use, to be fundamentally right from my viewpoint and from that of the patient's comfort. I do not wish to convey the impression that good dentures can be constructed only by a technic involving the principles that I am about to present, but I do wish to state that, after years of experience, I have found no occasion to doubt the correctness of this principle or to modify the technical procedure, although always on the alert to detect any shortcomings. Above all, we must not minimize discrepancies to favor a technic or a mechanism, but must put it to the severest tests to determine its compliance with obvious fundamental principles.

We have frequently heard it said that "if we could only use the patient's mouth as an articulator, our denture problems would be solved." Does this not prove that there is a "little something" missing in our technic which denies us the results we desire? Then why not use the jaws as the perfect articulating mechanism instead of depending on transfers to an imitation one?

When we consider the effect that the flexibility of the temporomandibular joint and the resiliency of the mucous cushion on which the denture bases rest have on the functional occlusal form of the teeth, we must be extremely optimistic to hope to develop them in any type of articulator that cannot possibly be equipped with a cushion denture base or a flexible temporomandibular joint. Nor can equivalent relations be recorded to harmonize with the many degrees of pressure that may be applied.

No articulating mechanism can have a flexible temporomandibular joint or a cushion denture base seat. It must be remembered that all anatomic factors exert a direct influence on the functional cusp planes under various degrees of pressure. It is therefore only reasonable that they should be developed intraorally, with necessary controls, so that these factors functioning together may develop a harmonious functional cusp path to conform to the varied degrees of pressure.

We are all familiar with the triangle and three point balance introduced by Bonwill. But may I call your attention to another interesting triangle that is a definite part of Nature's design, a cinematic triangle, with each of its angles moving in function. I call it the functional triangle of mastication and pivotal balance. Two of its angles are located in the temporomandibular joints and the

Read before the American Full Denture Society.

anterior angle is posterior to the anterior angle of the Bonwill triangle. It is located in the sagittal plane and in line with the buccal groove of the lower first molar.

If casts of an unmutilated set of natural teeth are placed in occlusion, we can easily recognize a rocking motion when applying pressure alternately in the molar and in the incisal region. The pivotal point will be at the buccal groove of the lower first molar, and in line with the anterior angle of this functional triangle. It is Nature's way of relieving the occlusal stress back of this pivotal point when the heads of the condyles are intruded into the glenoid cavity under extreme pressure. When the teeth are under light occlusal pressure, the first molar and bicuspids are in contact; but when heavy pressure is applied, occlusion is lost in the bicuspids and developed from the pivotal center backward. This clearance back of the pivotal or functional center compensates for the action of the flexible temporomandibular joint under various degrees of muscle pull when pivoting on the anterior angle of the functional triangle.

It is logical to believe that the lack of occlusion of the second and third molars under light pressure is caused by the intrusive movement of the heads of the condyles permitted by the flexibility of the temporomandibular joint, and in accommodating themselves to these varied conditions.

If, then, the action of the temporomandibular joint develops a pivotal center in natural teeth enabling them to function comfortably and without being traumatized under all conditions, why should we hope to construct comfortable artificial substitutes by ignoring Nature's requirements? We cannot hope to develop an occlusal form that meets the anatomic requirements by taking either light or heavy bite relations, using bite-rims for the anterior angle. These bite-rims act as flat surfaces of considerable size and will remain in contact only when the same biting pressure is used that formed them. When greater or less force is used, they will change their relation in accordance with temporomandibular joint flexibility. Dentures constructed according to this type of bite relation will have these errors incorporated in the occlusion and a shifting of the bases will result when different degrees of pressure are applied.

The degree of separation of these surfaces is influenced by the degree of the temporomandibular joint flexibility and the resiliency of the supporting tissues. Any decided separation of these surfaces may not be noticed under either light or heavy pressure, because the underlying mucosa may be of sufficient thickness to absorb it. But this force is definitely shifting the denture bases and will manifest itself in soreness of the mandibular ridge. When the denture bases are seated, however, by a center bearing point correctly located in the anterior angle of the functional triangle, the flexibility of the temporomandibular joint cannot cause distortion of the denture bases, which will remain seated without movement under either light or heavy pressure. By this means, it is possible to build an occlusal form that meets every anatomic requirement for either light or heavy biting pressure. The functional center is definitely a part of the natural dentition. This may be proved, first, by closing the teeth lightly, provided all the natural teeth are present. When there is a sense of contact in the region of the first molars and bicuspids, heavy pressure is applied and contact extending back to the second and third molars and release of contact in the bicuspid area will be noted. This test, which clearly demonstrates the flexibility of the temporomandibular joint under various degrees of pressure, is Nature's method of adjusting tooth relation to various degrees of pressure.

The mesiobuccal cusps of the upper

first molars are in line with this pivotol center, together with the buccal groove of the lower first molar, and this easily explains the damage caused to the dental arch by the removal of these key teeth. Secondly, by making accurate casts of a perfect natural dentition, as mentioned before, the rocking in the occlusion will be noted. This is not caused by inaccuracy of casts, but is Nature's plan of compensating for light and heavy pressure. Neither can the degree of second molar clearance be measured and used as a standard formula. To what extent it may intrude under heavy pressure depends on the degree of flexibility of the temporomandibular joint.

When we make these observations with casts of natural teeth, we study an occlusal condition that results from firm rooting of the teeth in the osseous structure. These teeth have very slight mobility and the relation remains practically constant, and yet we find this pivotal center definitely developed.

In constructing full dentures, however, on denture bases that were seated with light pressure, we cannot hope to have the same relation maintained after they are seated, nor can we hope to record centric and eccentric relations with unseated denture bases and expect them to remain permanent. It is therefore necessary to construct a denture base that is seated and remains so when the centric and functional relations are established. The relation of dentures cannot be correctly established by either light or heavy pressure alone, but a combination of the two will satisfy Nature's demands.

The seating of the denture bases is accomplished by sealing a center bearing jack in the palate of the completed upper denture so that it will engage the anterior angle of the functional triangle, located on the horizontal mandibular plate. The correct location of the anterior angle of the functional triangle is assured when the denture bases remain in that relation under rapid closure with either light or heavy pressure.

With the mandible positioned in correct vertical and gothic arch centric relation by the center bearing point, the denture bases are held under heavy pressure for from five to ten minutes. This seats the denture bases uniformly without shifting, and places them in the same relation that the completed dentures will be in when seated. With seated denture bases, we can then record relations with light and heavy pressure to satisfy the requirements of the structures involved. Therefore, when the seated denture bases are being sealed together in gothic arch centric relation with plaster, the heavy pressure is discontinued and the bases held together with light but firm contact. This establishes a mandibular relation, with seated denture bases, that is the same as the relation of the mandible with the natural first molars and bicuspids in light contact.

This seated denture base relation is now transferred to a rigid plain line articulator. The lower cast is removed from the lower arm and related to the new and corrected gothic arch centric relation. The first gothic arch centric relation was registered with an upper rosin baseplate and without being seated, with the knowledge that this incorporated an error which would become evident when the second gothic arch centric relation was developed with the completed upper denture. This procedure provides definitely accurate denture base relations.

It will be remembered that the teeth were accurately occluded in the first gothic arch centric relation, with a well adapted rosin baseplate and no heavy pressure, an error in mandibular relation resulting that could not be prevented at that time. This error will manifest itself when the mandibular bite-rim assembly is replaced by the lower teeth, which were arranged in wax to perfect the occlusion with the upper teeth from the original incorrect gothic arch centric relation. The degree of error cannot be described and can be appre-

ciated only by a practical demonstration. It is sufficient to state that it requires a complete rearrangement of the lower bicuspids and molars to correct the occlusion with the upper teeth to this new relation.

The lower teeth are now replaced by the bite-rim assembly and a guiding device added which allows for the development of a functional centric position and a 30-degree opening of the mandible vertically at the center bearing point in all eccentric relations.

This guiding device, frustoconical or saucer-shaped, is placed on the horizontal plane encircling the center bearing jack. It is then brought in firm contact with the anterior part of the center bearing jack and firmly secured to the horizontal plane. The guiding device has a circular inclined plane of a 30 degree angle from the horizontal and has a center circular opening 4 mm. in diameter. This opening allows the jack to travel protrusively 2.5 mm. on the horizontal plane before the mandible is guided in an opening movement, allowing the center bearing jack to travel on a horizontal plane forward from gothic arch centric to functional centric relation. This develops the protrusive clearance from the gothic arch centric to the functional centric position in the functional cusp formed wax pattern. It is within this space of 2.5 mm. diameter on the horizontal plane that the patient locates the functional center, by executing the masticating strokes, and by repeated vertical closing. The 30 degree inclined plane was selected to conform with anatomic cusp form and available 30 degree posterior teeth, although a 45 degree cusp form may be used to equally good, and in many instances better, advantage. A cusp form of less than 30 degrees is not suited to this technic, because natural or 30 degree cusp form demands a vertical component in the masticating stroke.

At this point, the lower bite-rim is built up to within one thirty-second of an inch from the cusps and incisal edges of the teeth in the maxillary denture with a hard baseplate wax, and a strip of softer wax is sealed on it.

The teeth of the upper denture are brushed with a thin coating of mineral oil or dipped in cold water and the articulator closed until the center bearing jack rests on the horizontal plate. All excess wax is trimmed flush with the buccal surfaces of the molars and bicuspids, and the labial surfaces of the cuspids and incisors, and reinforced with a sheet of stiff baseplate wax. The articulator is opened and the excess soft wax on the lingual side is trimmed to the approximate height of the tooth crown. The lingual surface of the soft wax is also reinforced with hard baseplate wax. This will hold the soft wax in position in developing the functional paths. At this point, a thin film of black carding wax is melted in the saucer-shaped device, through which the center bearing jack will trace its movements when the functional cusp paths are developed in the mouth.

This is the controlling equipment in and with which the mandible can function as Nature intended it to. It permits light or heavy biting pressure without shifting of the denture bases by permitting the mandible to pivot on the center bearing point in the anterior angle of the functional triangle.

Before developing the functional cusp paths, it is necessary at this point to grind the six anterior teeth of the maxillary denture for desired incisal form, so that this form may develop its functional path in the wax pattern, which eventually determines the incisal form of the six anterior mandibular teeth. The maxillary denture and mandibular baseplate assembly are returned to the mouth.

We are now working with a completed maxillary denture and a mandibular denture baseplate assembly that is seated on the same denture-bearing surface that the completed denture will cover. This assures the same accuracy of relation when the dentures are completed.

The denture bases are again seated with heavy pressure as they were when the gothic arch centric relation was developed. This provides a seated denture base relation for developing the functional paths and functional centric position that is in harmony with the gothic arch centric relation.

The functional paths are now developed by instructing the patient to open and close with a free and easy movement, gradually developing the protrusive and lateral movements.

Under no condition do we allow the mandible to move from the centric to an eccentric position with the maxillary teeth in contact with the mandibular wax assembly. This would shift the denture bases and produce a distorted functional path. All movements must follow in exact sequence from an opening movement to an eccentric position, then contact the wax in that position and slide back to centric position with light pressure and a uniform slide.

These movements are repeated until the center bearing jack traces a definite line through the thin film of carding wax lining the saucer-shaped device.

These paths were developed without extreme pressure into the moldable wax of even consistency. Beginning with a short lateral movement, the path is completed with an increasingly longer one, until it reaches the length about equal to the width of half a bicuspid.

When the functional paths are formed low enough to contact the center bearing jack with the 30 degree inclined plane, they will not take any change in form from continued movements, but will remain constant with a 30 degree vertical opening of the mandible. Whether the cusp height is low or high, as influenced by the condyle path inclination, the vertical opening of the mandible in eccentric positions will always be 30 degrees from the horizontal at the center bearing point.

When the functional paths are completed with normal biting pressure, the relief for intrusion of the head of the condyle under heavy biting pressure is provided for by applying as much pressure in functional centric relation as the patient can exert. Then, with a few lateral and protrusive strokes, the paths are complete. By this means, an occlusal form is developed that maintains seated bases under all degrees of pressure in accordance with Nature's plan of functioning from a pivotal center located in the anterior angle of the functional triangle. Light and heavy pressure was used in logical sequence, with the center bearing point definitely maintaining the same vertical relation. The accuracy of balance in the eccentric and centric positions may be checked intra-orally by noting the stillness of the denture bases when contacting in all these positions.

The maxillary denture and mandibular bite-rim assembly may now be removed from the mouth and subjected to further tests as to accuracy in balance.

It will be noted that the center bearing point established itself back of gothic arch centric relation or in functional centric relation, according to the requirements of the patient, and traced a line on the inclined planes when moving from eccentric to functional centric relation. To assure ourselves, however, that the functional paths conform to a balance on three points, we again glaze the black carding wax in the saucer-shaped device and seat the maxillary denture, with the center bearing jack still in position in the functional centric and eccentric relations. If the center bearing point shows definite contact with the horizontal plane in functional centric and on the inclined planes in the eccentric relations by displacing the carding wax when the maxillary denture is placed in these relations without developing rocking, we are definitely assured a balanced relation.

It must be remembered that the correct development of the functional paths requires a knowledge of what is to be ac-

complished. It should not be done carelessly or indifferently, since on the accuracy of these paths depends the perfect functioning of the dentures. Those who still construct dentures to a gothic arch centric relation would be surprised to see the difference in the cusp relation when the maxillary denture and mandibular baseplate assembly is returned to the relator which is in gothic arch relation. It can then be seen to what extent the mesial cusp inclines of the lower teeth make premature contact, causing the upper denture to move forward when closing in a natural functional relation. The degree of premature contact may not be the same on both sides, but conform to the anatomic condition and influences that developed them. The dentures, being adjusted to the gothic arch centric in addition to the functional centric relation, may function in either relation without cusp interference.

To develop this functional form in the mandibular teeth, a stone cast is poured into the functional cusp path form and luted to another upper arm of the articulator. The mandibular bite-rim assembly is removed and the lower teeth, set up in wax, are seated on the cast. The teeth are then carefully ground to this functional tooth form with small stones until the articulator is completely closed. Should they contact the functional cast too soon and require excess grinding, the lower cuspids and incisors should be removed and again reluted to position after grinding of the posterior teeth is completed. Then the incisal edges are ground just enough to develop the incisal functional form. The wax around the teeth is then warmed and the teeth pressed into vertical relation with the functional cast until the relator is closed. This places the anterior teeth at the correct functional height without excessive grinding of the incisal edge and destruction of the beauty of the tooth.

The lower waxed denture is now processed carefully to prevent excessive raising or displacing of the teeth. When removed from the flask, the denture must remain seated on the cast and, when thoroughly cleaned, it is replaced on the lower occluder arm. Any inaccuracies in the gothic arch centric relation and the functional form that may have developed in processing are removed by grinding and the denture is polished.

The dentures are now ready to be delivered to the patient and the teeth will never require any further grinding. When the patient receives them, the dentures must occlude in retrusion until the denture bases have an opportunity to seat themselves in the same relation in which they were when the gothic arch centric relations, the functional paths and functional centric relations were developed. The degree of retrusive occlusion depends entirely on the texture of the mucosa in the denture base area. The patient will experience increased comfort as the bases seat themselves, because it was anticipated and provided for in the technic.

In the event of shortening of the vertical dimension, the dentures must necessarily remain in balance, since they must occlude at some point in the protrusive functional path.

The functional occlusal form of the lower teeth allows free movement of the cusps of the upper teeth in all directions, which provides clearance for the escape of food when the masticating stroke is completed. This reduces the pressure required to a possible minimum, which is so necessary for comfort and efficiency in mastication.

This technic is not difficult. Each step follows in logical sequence, but, above all, accuracy is the keynote for a successful end-result.

I am using the patient's mouth as a perfect mechanism to reestablish normal function.

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ABRASION OF TEETH BY COMMERCIAL DENTIFRICES

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THE modern study of dentifrices and dentifrice materials was initiated in 1907 by Miller, who first reported cases of exposure and devitalization that resulted from the abrasive action of the dentifrice and toothbrush. He demonstrated on teeth mounted on plaster-of-Paris blocks, with an ordinary toothbrush, that, by crossbrushing the labial surface of the extracted teeth with various dentifrices popular at that time, it was possible to reproduce the characteristic lesion of toothbrush dentifrice abrasion.[1] A considerable number of dentifrices that he tested cut the teeth rapidly and nearly all cut to some extent. Even precipitated chalk wore the dentin away rather quickly, and prepared chalk, which contains variable amounts of harsh impurities, was still more abrasive. An excellent review of the desirable attributes of dentifrices was published by Gurley in 1913.[2]

In 1917, Gies reviewed the status of dentifrices, and brought forward cogent criticisms of some of the more popular dentifrices available at that time.[3] Later, Van der Merwe built a motor-driven machine in which teeth were brushed with natural bristle brushes running in a slurry of various common dentifrices.[4] Many products well known today were included in his study, although the formulas for most of these undoubtedly have been modified many times in the fifteen years since then. The amount of abrasion that he reported with some of these was quite large as compared with what has been observed recently from products of the same name. However, his results are difficult to compare with later ones, since the amount of pressure on his brushes could not be estimated and his gage for measuring the abrasion permitted only very coarse readings.

In 1929, Bodecker studied a particularly abrasive product being sold at that time, and pointed out that it had sharp-edged crystals which would be injurious to the teeth.[5]

The most recent additions to the dental literature in this field have been the contributions of Kitchin and Manly. Their studies were made under commercial auspices and the results have been exploited in extensive advertising campaigns for a new liquid dentifrice. In essence, Kitchin found, by surveying 200 patients in a dental clinic, that the degree of cervical exposure increased with age.[6] In those persons with an exposure of 1 mm. or more, there was an increased incidence of cuts transverse to the long axis of the tooth, which might have been caused by the abrasion of a brush. Evidence that this might be due to brushing was obtained indirectly by dividing the patients into one group with good oral home care and a second group in whom the mouths were obviously not well kept and in whom the teeth were seldom brushed. In the latter group, the amount of abrasion in those persons showing substantial cervical exposure was

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less than in those showing good oral care. Unfortunately, no observations were reported to show whether these abraded teeth, reaching as high as 42 per cent of the total, with cuts in excess of 0.5 mm. in depth in the age group 40 to 49 years, showed an increased incidence of caries, or whether mouths in which the abrasion was extreme had greater numbers of filled or missing teeth; so that the extent to which these grooves had impaired the vitality or the normal functioning capacity of the teeth involved was not established. It also was not demonstrated that these grooves were produced by any dentifrices of the composition of those now on the market. In fact, in view of the decreased abrasiveness of commercial dentifrices in recent years, there is a distinct possibility that the grooves which Kitchin reported as especially numerous in the older age groups were the result of damage sustained many years ago and unlikely to be caused today.

Manly compared the abrasion of cementum or dentin by ten commercial dentifrices with that of an unnamed liquid product.[7] The teeth were mounted in a casting and brushed with a motor-driven brush. Each tooth was measured directly and its contour recorded photographically before and after the brushing process, and the amount of abrasion determined by the differences in the measurements. The teeth, before mounting, were preserved in formaldehyde, and were dried at room temperature before being cast into a Wood's metal cylinder. Apparently, Manly failed to appreciate that teeth absorb fluid for many days after being dried and that measurements made during this period will show progressive increases in size until a new equilibrium or constant state of hydration is reached. He reported that the average abrasion from the liquid dentifrice was -8.8 microns. In other words, the teeth were 8.8 microns larger at the end of the abrasion period than they were at the beginning. This clearly indicates that there was considerable swelling in these teeth, although the magnitude of this cannot be judged from the data presented. Therefore, it is not possible to tell how much abrasion there actually was of the teeth brushed with the liquid dentifrice.

The pastes and powders compared with the liquid caused an average abrasion of 498 microns. The discrepancy between the abrasion from the liquid and the pastes and powders would not have been nearly so striking if the total true abrasion had not been partially counterbalanced by the swelling factor. However, there can be no doubt from these observations that the pastes and powders did actually abrade more than the liquid preparations and the published photographs give ample additional evidence that such was the case.

The liquid dentifrice presumably used in these studies depends for its cleansing powers on a sulfonated detergent made from higher alcohols, the one in question probably being sodium alkyl sulfate, since the Council on Dental Therapeutics reported in 1941 that Teel contained 2 per cent of this cleansing agent, together with 9 per cent glycerine, 31 per cent alcohol, gums and certain other materials of lesser importance.[8] The alkyl sulfates and related products have come into the dentifrice field relatively recently, the first scientific report on their useful properties in dentistry having been given by Kitchin and Graham in 1937.[9] In 1939, it was reported from our institution that these products were extremely powerful in depressing epithelial cells, being effective in concentrations below 0.002 per cent.[10] However, their activity in this regard was not much greater than that of the soap usually present in dentifrices when the concentrations used were taken into account. An extensive study of the systemic and local irritant effects of such products was made by us the same year. The general conclusion was drawn that, although the sulfonated detergents were

more irritating than soap, the concentrations used were sufficiently low to warrant the conclusion that the prospect of irritation was rather remote.[11] As their use also had no important systemic toxic effects, the possibility of chronic poisoning from repeated swallowing of small amounts in the saliva also seemed to be unimportant.

METHOD

As part of a survey of the abrasive effects of dentifrice ingredients and of the factors in abrasion, we have made tests of the abrasive action of about sixty commercial products in comparison with that of a standard precipitated calcium carbonate U.S.P. on human teeth. For this purpose, we have used the abrasion-testing machine described by us previously.[12]

In brief, the technic was as follows: Three mandibular molars were mounted in an upright position on each of a series of cast metal plates. The four tips of the cusps of each tooth, or twelve for each plate, were measured for height above the under side of the plate, with an extremely sensitive dial gage. Then the cusps were abraded with a toothbrush for 200,000 strokes in a slurry of the compound in question and remeasured. Special precautions were taken throughout to maintain a state of constant hydration, since it was found that the amount of swelling or shrinkage of the tooth in being changed from one liquid to another might be large enough to obscure some of the abrasion produced. The wear on a total of seventy-two cusps was measured by combining six runs of 200,000 strokes each, according to a round-robin procedure previously described, which exposed all the teeth to the abrasion of all the dentifrices and control materials.[12] In this way, the variability of the teeth themselves was largely cancelled by having all the teeth used for each individual product in a given run. Since the eighteen teeth used in such a round robin still might not be numerous enough to be completely representative of teeth in general, a standard of reference of precipitated calcium carbonate U.S.P. was always included as one of the materials and the abrasion calculated in terms of percentage of the abrasion caused by this chalk. For each test, there was calculated not only the amount of abrasion produced, but also the standard error of that value, in order that the possible variability could be judged. These standard errors must be taken into account in attempting to draw a conclusion as to the relative abrasiveness of any two products.

The product in question, if a paste or powder, was mixed with just enough 50 per cent glycerine in water to bring it to the thickest consistency, when it would flow readily over the surface of the tooth during the brushing procedure. If too dilute a slurry was used, the coarser particles might partially settle to the bottom of the cup and the true abrasive power of the preparation would not be revealed. If too thick a slurry was used, the brush would wipe this off the surface of the teeth, and thereafter complete abrasion would not be secured. The agitation from the brush, together with the viscosity of the slurry, prevented sedimentation adequately, so that no special stirring device was necessary.

We have demonstrated previously that variations in the concentration of the slurry do not appreciably modify the amount of abrasion.[12] The 50 per cent solution of glycerine in water was used as the liquefying material, since this did not evaporate appreciably during the twenty-four hours for the usual test. The teeth were soaked in this solution after mounting for a sufficient number of days to reach a constant size before they were used in the tests. A few dentifrices tested were supplied for this purpose by the manufacturers, the remainder being obtained locally at the time of use. The results obtained are presented according to types of products tested.

POWDERS

In Table 1, the amount of abrasion by the powders is recorded in terms of percentage of the control calcium carbonate.

TABLE 1.—RELATIVE ABRASION OF TEETH BY COMMERCIAL TOOTH POWDERS*

Tooth Powder	Amount of Liquid Added Per Cent	Mean Abrasion Per Cent	Standard Error of Mean Abrasion Per Cent
*Arm and Hammer Sodium Bicarbonate	33	47	± 9.3
Craig-Martin	33	47	± 9.0
Fuller's	40	67	± 9.4
Pycope*	29	68	±13.7
Revelation	57	69	±10.4
Pepsodent	38	70	±10.3
Nordenta	38	72	±13.5
Aluminum Hydroxide-Breon	40	85	±12.4
Pebeco	46	85	±10.7
Leslie's Iodized Salt	22	88	±12.8
Calox	43	92	±17.5
Detoxol	37	92	±12.4
Zanol*	33	92	±15.5
Listerine	48	95	±12.1
Calcium Carbonate Precipitated, Control*	67	100	±17.3
Caroid	58	112	±10.3
Ephraim*	47	118	±17.7
Iodent No. 2	33	152	±29.1
Williams	37	162	±18.3
Dr. Lyons	38	166	±24.0
Iodent No. 1	33	187	±31.6
Squibb	50	201	±29.9
Pepsodent Polishing Agent	36	227	±28.8

*In Tables 1 and 2, abrasion is recorded in terms of percentage of abrasion by precipitated calcium carbonate U.S.P., used as a standard of reference, in 200,000 strokes on eighteen human teeth for the commercial products, and 150 teeth for the control calcium carbonate. The products marked with a star are accepted by the Council on Dental Therapeutics. Fifty per cent glycerine in water was used as a liquefying agent.

Included in this table is "Pepsodent Polishing Agent," which is not a dentifrice for lay use, but a special powder of 93 per cent sodium metaphosphate and 7 per cent tricalcium phosphate, described in Accepted Dental Remedies for 1940.[13] Aside from this product, these powders had an abrasion range from 201 to 47 per cent of the control calcium carbonate, approximately two-thirds being less abrasive than U.S.P. chalk. The most abrasive of the entire group of powders was only twice as active as the chalk, which probably does not represent too great a degree of abrasive power. The "Pepsodent Polishing Agent" at 227 per cent was not unduly abrasive in view of the fact that this is designed for "prophylaxis" at the chair and therefore would be used on any person only infrequently,

TABLE 2.—RELATIVE ABRASION OF TEETH BY COMMERCIAL TOOTHPASTES

Tooth Paste	Amount of Liquid Added Per Cent	Mean Abrasion Per Cent	Standard Error of Mean Abrasion Per Cent
Hydrogel-Breon	22	42	± 7.1
Benetol	37	56	±12.9
S. S. White	26	61	±15.3
Castilla	17	67	± 8.7
Ephraim*	33	75	±13.5
Pebeco Regular	33	78	±11.7
Iodent No. 2	33	80	±12.0
Craig-Martin*	33	82	±13.1
Pepsodent	33	83	±11.6
Dr. Strasska's	33	86	±12.0
Worcester Salt	33	88	±15.8
Listerine	33	91	±14.6
Kolynos*	29	96	±11.5
Fuller's	33	99	±20.8
Calcium Carbonate Precipitated, Control	67	100	±15.0
Zanol*	17	101	±26.1
Colgate	33	116	±16.2
Ipana	33	116	±17.4
Iodent No. 1	33	120	±18.0
Lactona*	17	123	±20.5
Pebeco open formula	17	127	±24.0
Detoxol	17	128	±19.3
S. T. 37	22	131	±18.3
Squibb	33	138	±17.9
Regnum	17	142	±39.5
That's Mine	22	144	±18.0
Forhan's	17	151	±33.3
Bost	33	156	±23.4

and would be applied uniformly to the surface of the tooth if used in a rubber cup or rotary brush.

PASTES

In Table 2, the abrasion produced by a similar group of tooth pastes is recorded. Again the abrasion falls within about the same range, 42 per cent being that of the least abrasive paste and 156 per cent that of the most abrasive.

It seems that there was a slight tendency for the pastes to be more abrasive than the powders. However, there are twelve commercial products represented by both pastes and powders in the two series. Comparison of the relative abrasion of the paste and powder of each of these pairs reveals that there is no consistent tendency for one to be more abrasive than the other. In a few instances, the difference between the paste and powder is greater than would be expected if the same major ingredients were used in each. It may well be, therefore, that, in these, the manufacturers use different grades of abrasive materials in the two preparations rather than the same formula for each, modified only to the extent necessary to produce a paste from the powder.

BAKING SODA AND SALT

In an attempt to learn something of two soluble salts frequently used, and over which there has been some controversy as to possible injuriousness as dentifrices, a commercial brand of household table salt (NaCl), or sodium chloride and the Arm and Hammer Brand of sodium bicarbonate ($NaHCO_3$) were tested along with commercial dentifrices. Sodium chloride had an abrasive value of 88 per cent; sodium bicarbonate, a value of 47 per cent. Both are significantly lower than the control chalk and are only moderately abrasive. Here, for the first time, is a controlled comparison of these readily available household products that can well be used as dentifrices; first, because they do have some abrasive or polishing action and, second, because they produce a chemical change in the adherent mucin deposits, changing them to soluble and more readily removable sodium mucinate.

TABLE 3.—RELATIVE ABRASION OF TEETH BY COMMERCIAL LIQUID DENTIFRICES AND CERTAIN CONTROL MIXTURES*

Preparation	pH	Number of Teeth Tested	Amount of Liquid Added Per Cent	Mean Abrasion Per Cent	Standard Error of Mean Abrasion
Teel	5.75	36	5	17	± 3.0
Cue	4.81	18	20	30	± 5.9
Pepsodent Liquid	5.65	18	20	34	± 3.7
Nu-Sol	6.25	18	20	44	± 9.0
Craig-Martin	4.15	36	0	49	±12.8
Vray	5.11	54	0	110	±17.0
50% glycerine in water	5.55	36		64	±17.0
Calcium carbonate precipitated, control	8.50	105	67	100	±14.0
1.5 gm. sodium alkyl sulfate, 20 gm. calcium carbonate precipitate, 50% glycerine in water (40 cc.)		54		59	± 8.8

*Abrasion recorded in terms of percentage of abrasion by precipitated calcium carbonate U.S.P., used as a standard of reference. Where necessary, 50 per cent glycerine in water was added as a liquefying agent to obtain the proper consistency for test.

LIQUIDS

In Table 3 are presented the results of tests of six liquid dentifrices. With one exception, their abrasion was only from one-sixth to one-half that of the control powder. However, it will be noted that one, namely "Vray," caused an abrasion of 110 per cent, which was more than that of the other liquids, and even possibly slightly greater than that of the control calcium carbonate powder. This product consists of a suspension of solid powders in a viscous liquid, so that it is intermediate between the true liquids and the semisolid pastes. In addition, it seems to have some unique chemical property, since the metal plates on which the teeth were mounted turned bright after having been exposed to Vray. This occurred despite the fact that the plates were not hit by the brush and were exposed only to the chemical action of the product. This effect is not due to acid in this dentifrice, since measurements with a glass electrode showed that this one was not more acid than the others. (Table 3.) There is probably some constituent, such as a reducing agent, in this product which is not in the other dentifrices studied and, which causes it to brighten the metals.

Included in this series of observations for comparison are the results of brushing the teeth only with the liquid used (50 per cent glycerine in water). This series might be considered a control on the amount of abrasion caused by the wet brush. The abrasion was 64 per cent (Table 3). In other words, a synthetic bristle brush of the type used, when lubricated by glycerine in water, abraded the teeth approximately two-thirds as much as did the medicinal grade of calcium carbonate used as the standard of reference. In contrast to this, the other liquid preparations, except Vray, were much less abrasive than even the glycerine in water. In fact, the abrasion produced by the least abrasive of these was less than one-third that caused by the glycerine in water and only about one-sixth that caused by the calcium carbonate. Therefore, it appears that these liquids presumably get from the sulfonated detergents a lubricating action which permits the bristles to slip easily over the tooth and cause less wear. An alternate possibility might be that they soften the bristles of the brush to such an extent that a lesser abrasive action occurs. However, we have seen no evidence that brushes used for these particular detergents are unusually soft at the end of the run. In addition, natural hog bristles, when wet, are softer than the synthetic, and yet have been demonstrated by us to cause more abrasion than the synthetic bristles used here,[12] so that softening of the bristles seems an unlikely explanation.

ALKYL SULFATE

To determine whether the alkyl sulfate detergent in the liquids actually has the high lubricating power suggested by these results, a special test was made in which, to the control calcium carbonate, was added sodium alkyl sulfate in a concentration similar to that in the liquid dentifrices. It was observed (Table 3) that the amount of abrasion produced by the calcium carbonate under these conditions was reduced to 59 per cent of that in the control employed on the same teeth from the same chalk alone. In other words, the alkyl sulfate definitely diminished the abrasion produced by the solid powder by about one-half, or to about the level of that caused by the wet brush alone. This, therefore, is consistent with the suggestion that the reduction in abrasion produced by the liquid dentifrices (Table 3) was due, at least in part, to the alkyl sulfate. It is also probable that the gums present in the liquid dentifrices contributed to this lubricating action. Undoubtedly, some of the powders and pastes also contain a sulfonated detergent rather than soap, with a resultant similar decrease in their abrasive power.

COUNCIL ACCEPTED PRODUCTS

The products which have been accepted by the Council on Dental Therapeutics as indicated in the eighth edition of Accepted Dental Remedies are marked with a star in Tables 1 and 2. It will be noted that they comprise about one-fourth of the powder and paste products. In the Council Accepted group are found mainly the less abrasive products. Inasmuch as these accepted brands are advertised without exaggerated and unfounded therapeutic claims, it can be seen that an ethical product of adequate cleansing power can be readily selected without going outside the Council's list.

None of these liquid preparations has been accepted by the Council on Dental Therapeutics, possibly because there has been as yet no decision as to whether the amount of abrasion caused by them is adequate for cleansing. In fact, it is freely admitted in connection with at least one of these that additional abrasive action to keep the teeth clean should be sought periodically by using a powder once a week. In addition, it is well known that certain of these liquid preparations are advertised with exaggerated claims, or with "scare" types of advertisements, which would make them unacceptable according to Council standards.

DISCUSSION

Among the products tested by us, and which are probably representative of the more commonly used dentifrices, there are no compounds so unduly abrasive as to be clearly objectionable. The day when pumice, cuttlefish bone and other highly abrasive materials were included in commercial dentifrices is definitely past. All of these products have, we believe, a range of abrasiveness that renders their use over many years, with a correct brushing technic, unlikely to cause any serious harm to the teeth. However, it is interesting to note that those dentifrices that are promoted with the most blatant type of advertising—those advocated with striking words or phrases: "whyten," "bryghten," "dull dingy stains," "smile of beauty," "do as your dentist does," etc.—are among the most abrasive.

In the mouths of a reasonably high percentage of persons, the use of the alkyl sulfate liquid dentifrices results in uncleanliness of the teeth in spite of vigorous brushing. Over their entire cosmetic surface, the labial surfaces exposed to light are covered with a resistant brown or black stain. A peculiar strain of chromogenic organisms in the oral flora of the susceptible person may find the alkyl sulfate or the vegetable gum base of the solution an excellent culture medium for growth and subsequent pigmentation.

As to whether the liquid dentifrices, with their almost complete lack of abrasive power, are desirable remains to be settled by future investigations and clinical observations. No one will object to the basic assumption that a certain degree of abrasion is desirable in order to remove the adherent mucous and other adsorbed protein materials or stains from the teeth. For some persons in whom the amount of this stain is minimal, a very slight degree of abrasion, such as is afforded by the use of a liquid dentrifice or even just a wet brush, may be adequate to keep the teeth in a satisfactorily clean condition. For many persons, however, this slight amount of abrasion is not sufficient, since, in the advertisements for the liquids, statements are made that if the teeth are not kept clean by use of the liquid, they can be brushed with a more abrasive powder once a week and thereby become clean at least that often. If it is desirable to get the teeth really clean once a week by the use of a moderately abrasive powder, it is at least conceivable that it might be still more desirable to keep them that way by the use of an adequate cleansing material in the first place.

Wearing away of teeth from mastica-

tion, and from malocclusion is, of course, a well-known phenomenon. It is not, however, a common cause of tooth failure, since the wear is produced so gradually that laying down of secondary dentin and recession of the pulp are apparently able to keep ahead of the process of attrition. It is possible that the very slow abrasion in the cervical regions reported by Kitchin and Manly may be much the same, and may be more theoretically than practically objectionable. If these grooves do not result in a functional failure of the tooth over a normal life span, this may be a price that might well be paid for keeping the teeth in a hygienic and clean condition and the mouth free from odors. If, however, this abrasion leads to failure of the tooth as a functioning member of the body, it will of course, be objectionable, and other ways of cleaning will have to be used.

At present, there is no adequate factual basis for a conclusion as to the functional importance of such grooves in the necks of the teeth, and such evidence as is available has been secured under the auspices of a manufacturer with a direct commercial interest in the results of the investigations. In view of the fact that such grooves have not been demonstrated to be caused by the use of dentifrices now on the market, and that grooves of the depths reported have not been actually demonstrated to be a serious cause of tooth failure, it would seem desirable not to abandon the use of the ordinary dentifrice materials until more convincing evidence as to their harmfulness is brought forward. Possibly the needs of the situation could be met by using the pastes or powders shown here to cause degrees of abrasion similar to that of the liquids.

Careful consideration of Kitchin's report leads to the conclusion that he mainly reaffirms a frequent clinical observation: the older the patient-age group, the greater the amount of recession of the cervical gingiva, resulting in a proportional increase in the amount of tooth exposed below the cemento-enamel junction. If no infectious or traumatic injury has been responsible, this condition may be attributed to a physiologic change with age. The patient who uses a toothbrush vigorously will increase the rapidity and degree of recession, with resultant exposure of the thin cementum covering the root surface beneath the cemento-enamel junction. The mechanical action of the toothbrush with or without a dentifrice across this exposed area may cut a wedge-shaped groove through the cementum and dentin in those areas most accessible to the toothbrush, particularly where the brush is driest, the dentifrice most concentrated and the maximum application of pressure possible. It is very infrequent that a condition of toothbrush and dentifrice abrasion can be found on any other surface of teeth than the labial or buccal, or, in a sense, the cosmetic surfaces. Only in mouths reflecting good home care are abrasion and early recession marked. However, the problem is not so much what should be used on the toothbrush as how it should be manipulated.

Too much emphasis is placed on the importance of dentifrices in oral prophylaxis. Some persons lose sight of the fact that dentifrices are mainly of cosmetic value or an adjuvant to the toothbrush. The soap or alkyl sulfates have some specific value in that they aid in removal of débris by wetting and by lowering surface tension. A toothbrush correctly designed as to size and shape of the brush head, texture and arrangement of the bristles and length and rigidity of the handle is still more important. But the most important ingredient in oral hygiene is "time."

The dentist must be interested in teaching and willing to teach the patient, whether child or adult, to use a toothbrush for maximum effect and a minimum of traumatic and abrasive injury.

Briefly, this implies a method of vertical brushing starting on the ginigva, using the sides of the bristles with the ends pointed toward the apex of the tooth and the movement of the brush in a sweeping motion toward the occlusal surface without rotating the brush head or using the ends of the bristles. By such a brushing technic, the chance of causing abrasion, regardless of the dentifrice used, will be reduced to negligible proportions.

CONCLUSIONS

1. A number of commercial powders, pastes and liquid dentifrices have been tested as to their abrasive action on human teeth under standardized conditions using motor-driven brushes. A specially selected precipitated calcium carbonate U.S.P. was used as a standard of reference for comparison with the commercial products.

2. The least abrasive pastes and powders were about one-half as abrasive as the control calcium carbonate, and the most abrasive were about twice as abrasive as the control.

3. It is probable that the sixty commercial products tested were all satisfactory as to the degree of abrasion produced, inasmuch as evidence as to the permissible degrees of abrasive power in such products is not thus far available.

4. When the toothbrush moistened with equal parts of water and glycerine was used alone the abrasion was reduced to about two-thirds of that caused by brushing with calcium carbonate powder moistened with the same liquid.

5. Five liquid dentifrices caused very little abrasion, ranging down to as low as one-sixth that of the control calcium carbonate. Since this was less than that produced by the brush alone when wet with glycerine, the diminished abrasion resulted from lubrication by the sulfonated detergent and gums used as substitutes for soap in these liquid preparations.

6. That the sulfonated detergents possess a high lubricating power was shown by adding sodium alkyl sulfate to a slurry of the control calcium carbonate powder in glycerine and water; the abrasion diminishing to about one-half that from the calcium carbonate without the alkyl sulfate.

7. One of the semiliquid dentifrices was as abrasive for the teeth as the control calcium carbonate powder and, in addition, produced a bright luster of the metal plates through direct chemical action. Presumably this preparation contained ingredients not present in the other liquid products tested.

8. Household brands of table salt and baking soda possess abrasion efficiency indistinguishable from that of the specially formulated dentifrices, this fact giving support to previous claims that these simple materials may serve quite adequately as economical dentifrices.

9. No answer can be given at this time to the question of the ideal degree of abrasion required for dentifrice preparations. The liquids clearly cause less abrasion than the powders or pastes, but, in many persons, these products apparently fail to abrade sufficiently for proper cleansing. There appears to be no choice between pastes and powders as to the degrees of abrasion produced, since, in general, these have the same range of abrasiveness. However, there are wide differences between the most and the least abrasive pastes and powders, so that, if the teeth are not adequately cleaned by one product, a more abrasive one may be selected. The most abrasive pastes and powders are approximately four times as abrasive as the least effective, so that a wide range is available for selection. Since the least abrasive solid preparations have substantially the same abrasive power as most of the liquid dentifrices, if minimal abrasive effect is desired a properly selected paste or powder can be used with as great a degree of safety as most liquid dentifrices.

BIBLIOGRAPHY

1. MILLER, W. D.: *D. Cosmos,* 49:109, February 1907.
2. GURLEY, J. E.: *Pac. D. Gaz.,* 21:1, January 1913.
3. GIES, W. J.: *J. Allied D. Soc.,* 12:360, September 1917. GIES, W. J., and HARSHEN, M.: *J. D. Res.,* 2:293, June 1920. GIES, W. J.: *J. D. Res.,* 2:299, June 1920, Dentifrice Problem. *J.N.D.A.,* 8:851, 1921.
4. MERWE, VAN DER S. W.: *J. D. Res.,* 7: 327, September 1927.
5. BODECKER, C. F.: *J. D. Res.,* 9:173, April 1929.
6. KITCHIN, P. C.: *J. D. Res.,* 20:665, December 1941.
7. MANLY, R. S.: *J. D. Res.,* 20:583, December 1941.
8. Council on Dental Therapeutics: Teel—Not Acceptable to A.D.R. J.A.D.A., 28:1682, October 1941.
9. KITCHIN, P. C., and GRAHAM, W. C.: Sodium Alkyl Sulfate as Detergent in Tooth Paste. J.A.D.A., 24:736, May 1937.
10. PERRINE, R. L.; THRONDSON, A. H., and TAINTER, M. L.: *J. D. Res.,* 18:81, February 1939.
11. EPSTEIN, SIDNEY, *et al.:* Possible Deleterious Effects of Using Soap Substitutes in Dentifrices. J.A.D.A., 26:1461, December 1939.
12. TAINTER, M. L., and EPSTEIN, SIDNEY: *J. Am. Coll. Dent.,* 9:353, December 1942.
13. Accepted Dental Remedies. Ed. 6. American Dental Association, 1940, p. 106.

IMPROVEMENT ON THE PROCEDURE OF TOPICAL APPLICATION OF THE SULFA DRUGS

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MUCH has been written concerning the use of the sulfa drugs immediately after extraction in an attempt to prevent postoperative pain, swelling and infection. The object of this paper is to suggest an improvement in the topical application of sulfanilamide or sulfathiazole. I have found that the following procedure gives definitely favorable results.

Prior to the operation, a tablet of the drug to be used is crushed into powder (sterile crystals of the drug are to be preferred if they can be secured). Application of a sterile gauze exodontia sponge to the wound follows extraction, to absorb the blood and accumulated saliva. The powder is placed in the wound and pressure is brought to bear on the area by means of a sterile exodontia sponge, folded and saturated in sterile mineral oil. This sponge is retained in place by the patient's closing the jaws. The compression upon the saturated sponge causes oil to spread out over the area and cover the wound. This prevents the saliva from entering the clean wound and contaminating the blood clot that has formed. The sulfa drug remains in the wound and a clot is established, enclosing the crystals. Thus, the possibility of infection is lessened. The patient is instructed to leave the pad in place for at least a half-hour and not to rinse the mouth for at least four to six hours.

I have followed this procedure for a period of several years. While resident dental surgeon at the San Francisco General Hospital, caring for facial maxillary injuries, this procedure was used in injuries resulting from accidents comparable to combat, and favorable results were obtained.

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EXPERIMENTAL STUDIES ON CARIES
II. A RAT CARIES INDEX

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THE first essential in a study of the factors in the production or prevention of caries is the establishment of a statistically valid caries index. Many such indices have been established for human teeth, but, for rat teeth, the caries index of Rosebury and co-workers[1] seems to be the most satisfactory to date. Since their work is open to a number of objections, which will be discussed later, it has seemed advisable to approach the problem of rat caries uninfluenced by previous work, except for the use of the Rosebury modification of the Shibata caries-producing diet.

METHOD

Fourteen female and twenty male rats were maintained for 100 days on a caries-producing diet composed of 66 per cent unground corn, 30 per cent milk powder, 3 per cent alfalfa meal and 1 per cent iodized sodium chloride. The rats were placed on the diet at 34 days of age and were killed at the end of the experimental period. The jaws were dissected and the crown portions of all the molars of each rat were placed in liquefied phenol in accordance with the technic of Leicester and Schamp.[2] Figure 1 shows the effect of this technic in rendering the entire jaw translucent, as compared to a normal jaw. Figure 2 is an occlusal view of a carious upper third molar following similar treatment. The teeth, when all had become translucent, were examined under the dissecting microscope, and those that gave no evidence of caries, as judged by the yellow hue produced in carious material by contact with the phenol, were separated. In all cases in which any doubt existed, the teeth were treated like those that were obviously carious. All the carious lesions evaluated were of the fissure type. To obtain a more satisfactory view of the lesions, the teeth were split in half vertically, by means of a small chisel, and preferably mesiodistally, as shown in Figures 3 and 4. The halves were then examined under higher magnification (×100-400). Under these conditions of three dimensional observation, it was easy to determine the point of deepest penetration of the caries. This point was used to evaluate the degree of caries for the index described below. After a little experience, it became quite easy in most cases to differentiate the stages of caries.

RESULTS AND DISCUSSION

The method of sampling used by Rosebury *et al.* is not made sufficiently clear in their paper to permit of repetition and confirmation by other workers. However, it would seem that their reliance on the study of only three molars out of twelve from each rat would be hazardous, unless they had statistically validated this procedure. By employing the method described above, it was possible in the present series to use all the molars from each rat and thus obtain a more nearly complete picture. In an attempt to standardize the technic, the rats

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were placed on the diet at 34 days of age and maintained on it for 100 days, both the age and the time factors thus being controlled.

Although Rosebury *et al.* used a total of 123 rats in their series of experiments, no single experimental group contained more than eleven animals and, in several experiments, only three rats were used. This fact was justified by them on the grounds that the similarity in appearance and severity of caries as a result of any given diet made a small number of animals sufficient. In view of the sampling method used, it is doubtful whether this assumption is valid. In our series of thirty-four rats, assumptions as to the validity of sampling were unnecessary since all the molars of each animal were examined, and the number of animals in this single group was sufficient for statistical analysis.

TABLE 1.—INCIDENCE OF FISSURE CARIES IN CONTROL RATS ON CORN CARIES-PRODUCING DIET

Number of Animals	Sex	Number of Lesions	Number of Carious Teeth						Carious Teeth Per Cent
			Upper			Lower			
			1	2	3	1	2	3	
20	♂	78	8	4	26	6	13	15	30.0
14	♀	56	4	8	15	14	9	4	32.1
34	Total	134	12	12	41	20	22	19	30.9

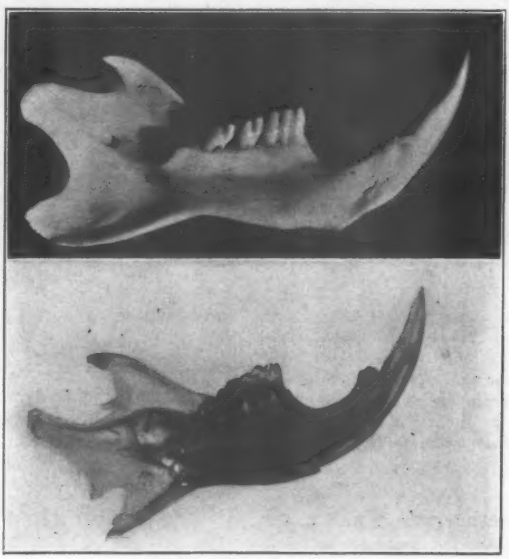

Fig. 1.—Comparison of rat mandibles untreated and treated with liquefied phenol. The upper picture shows a normal mandible photographed by reflected light. The lower picture shows a translucent mandible photographed by transmitted light. The pulp chambers and root canals appear as dark areas in the cleared mandible.

Since one purpose of this study was to devise a numerical rating scale to evaluate the incidence of that type of caries which is analogous to human caries, as a control for future experiments, the observations were limited to fissure caries. It is recognized that fracture caries is not analogous to any condition in man and the analogy of proximogingival caries is open to question. The data are, therefore, presented for fissure caries only. The caries index is made up by evaluating the various stages of penetration by the carious process and summating these for the twelve molars of each rat to get an index figure indicative of the total caries present in that animal. The stages are listed below:

1(I). Incipient caries. Penetration of only a portion of the enamel.

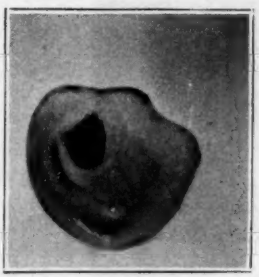

Fig. 2.—Occlusal view of crown of cleared, carious upper third rat molar. (×20.) The very dark impacted food in the fissure, the somewhat lighter carious enamel surrounding it and the clear dentin are to be noted. The lines in the tooth to the right of the fissure appear frequently and seem to be fault lines in the enamel.

1(L). Lamellae caries. Penetration through lamellae to the enamel junction with no spreading.

2. Carious enamel. Diffuse penetration, to but not including the junction.

3. Carious enamel. Diffuse penetration to the junction with spreading of one-half the intercuspal distance or less.

4. Carious enamel. Diffuse penetration to the junction with spreading of more than one-half the intercuspal distance.

5. Carious enamel and dentin. Tubular penetration one-third of the way to the pulp or less.

6. Carious enamel and dentin. Tubular penetration between one-third and two-thirds of the way to the pulp.

7. Carious enamel and dentin. Tubular penetration from two-thirds to all the way to the pulp (pulp involvement left an open question).

8. Carious enamel and dentin. Surface of enamel broken except on height of cusp and involving some dissolution of dentin.

9. Carious enamel and dentin. Surface of enamel broken except on height of cusp and involving dissolution of dentin as deeply as the pulp.

Fig. 3.—C, cusp. D, dentin. E, sound enamel. The arrow indicates the carious lesion of stage 1(L).

10. Carious enamel and dentin. Cusp fracture of only one side of cusp toward the carious area.

11. More severe lesions without possible involvement or origin in fracture caries (in clear-cut cases only).

It will be seen that this arrangement is essentially that of Rosebury *et al.*,[1] which has been modified slightly to bring out the distinction between certain types of caries which apparently were not observed by the earlier workers. Thus,

several cases were noted in which caries had not penetrated the enamel completely to the dentino-enamel junction, and this appeared to deserve its own classification. 1(I) and 1(L) were considered to be equivalent stages in the development of caries, but deserved separate classification to indicate different degrees of susceptibility. The final caries index for each animal was obtained by totaling the numerical values for all the lesions as designated by the classification number for each stage, and noting, in addition, the number of 1(I) and 1(L) cases. Thus, the caries index, as reported, represents a resultant of both the susceptibility and the severity. It was hoped that only 100 days on the diet would produce few lesions of a severity of stages 10 and 11, as the uncertainty of similarity to human caries is greater in these stages. If the experiment were continued for very long periods, cases in which fissure caries and fracture caries occur in the same cusp would become more frequent, and confusion as to origin would be increased.

Figure 4 shows a case in which such confusion might have arisen, had the fissure caries become sufficiently severe to cause destruction of the already broken cusp. As in the table of Rosebury, the susceptibility of enamel is indicated by the number of lesions of stages 1 and 2, and the susceptibility of dentin is indicated by the proportion of stage 5 or later stages to less severe lesions. Possibly the proportion of lesions of stage 4 to those of stage 3 indicates the relative speed of caries extension at the dentino-enamel junction, other things being equal.

Table 1 is the summary of the results. The median caries index is 13; the upper and lower quartiles are 19 and 5 respectively; and the individual caries indices varied from 0 to 36. Two of the 34 rats on the diet showed no caries.

Fig. 4.—D, dentin, E, sound enamel. Fr, fractured cusp. P, pulp chamber. The arrow indicates the carious lesion of stage 4.

The greater susceptibility of the upper third molars is exceptionally noteworthy. Much speculation is possible as to the reason for this, but no evidence has yet been presented which adequately explains this fact.

Figures 3 and 4 were obtained from photomicrographs taken at 100 magnifications with transillumination using green light. The green light was used to emphasize the color distinction between yellow-to-brown carious material and sound tooth structure. The resulting photographs show certain dark lines and

areas which are artefacts of no significance and which are not visible to the eye.

Figure 3 is an example of lamellar caries, stage 1(L). In this mesiodistal section, the enamel-free tips of the cusps and a fissure lined with enamel, in which there is lamellar caries, can be observed. Since this is a three-dimensional picture, the apparent irregularity in the dentin directly below the fissure is merely the continuation of the fissure into the tooth structure below the plane of focus.

Figure 4 is an example of caries of stage 4. In this mesiodistal section can be seen a fractured cusp with no apparent decay; the enamel of the adjacent cusp attacked by caries; the spread of caries at the dentino-enamel junction; the apparently sound dentin, and one horn of the pulp chamber. In such a case, greater development of the carious lesion, with further fracture of the cusp, would have led to confusion as to the origin of the lesion.

Figure 5 shows an example of caries of stage 7. In this mesiodistal section can be seen the enamel-free top of one cusp; the enamel attacked by caries on one side; the spread of caries at the dentino-enamel junction, and the involvement of the dentin as far as one horn of the pulp chamber. Whether the pulp is involved cannot be discerned because of the limitations of this method. The dark areas in the enamel and at the dentino-enamel junction at the left of the figure, which are due merely to a reflection as recorded by the camera, do not appear when the tooth section is examined directly.

Fig. 5.—T, tip of cusp. E, enamel. D, dentin. P, pulp chamber.

SUMMARY

1. The liquefied phenol technic for rendering teeth transparent has been applied to the detection and evaluation of carious lesions in rats' teeth.

2. The number and severity of various lesions in each of the molars have been determined for thirty-four rats, which were maintained for 100 days on a coarse corn caries-producing diet. In all, 408 teeth were examined.

3. A modified rating scale for expressing the susceptibility and severity of the carious lesions has been suggested. In terms of this scale, the median caries index for this group was 13, with a quartile distribution of from 5 to 19.

4. Our method gives a measure of the total caries produced in an animal more easily than other methods in common use.

BIBLIOGRAPHY

1. ROSEBURY, THEODOR; KARSHAN, MAXWELL, and FOLEY, GENEVIEVE: Studies in Rat of Susceptibility to Dental Caries. IV. Further Studies. J.A.D.A., 21:1599, September 1934.

2. LEICESTER, H. M., and SCHAMP, H. M.: Experimental Studies on Caries. I. Technic for Clearing Teeth. J.A.D.A., 29:1649-1651, September 1, 1942.

DENTAL PROCEDURE FOR MAINE NATIONAL YOUTH ADMINISTRATION RESIDENT CENTERS

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THE National Youth Administration resident centers are engaged in training young people for necessary war trades, such as airplane engine maintenance, sheet metal working, welding and radio. These youth learn an essential trade and pass out into vital war industry and the armed forces so rapidly that only a small portion of their dental needs can be met by the existing program. Indeed, the primary object of the dental clinic during these grave times is fully attained by prevention of the loss of appreciable time from the machines because of dental pathologic conditions. Education to show the need for complete dental care on the individual's own responsibility is stressed.

In the light of these facts, the following outlined procedure was designed as an aid to be generally followed at the resident centers.

I. Picture of average boy (approximately 350 cases) aged 17-24.

(a) Seven surfaces require filling.

(b) One tooth requires extraction.

(c) Seven surfaces previously filled.

(d) Two teeth previously extracted.

II. Method of Procedure.

(a) Emergency work performed at once (no appointment) in order to keep all men fit to work at all times.

1. Exposed pulps; teeth extracted.

2. Painful carious teeth; simple excavations and temporary relieving treatments, such as with zinc oxide and eugenol.

3. Acute and infectious conditions of the soft tissues treated.

(b) Constructive work, by appointment.

1. Gross examination is made for classification (sixty boys per hour approximately).

No explorer, tongue depressor type examination.

To discover for each boy:

a. Number of obvious fillings needed.

b. Number of obvious extractions needed.

c. Total number of teeth affected (= a plus b).

d. Miscellaneous and soft tissue conditions.

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Boys are classified according to c, this theoretically giving thirty-three groups, from zero group (no bad teeth) to group No. 32, men having all thirty-two teeth pathologic.

2. Regular appointments are then given from these groupings, in general working backwards from the higher number (more severe) cases.

3. When only a few dental hours per week are available, it is recommended that the regular appointment be of one-half hour's duration. Little constructive work can be accomplished in less time than this, and more time would prevent the dentist from helping all but a very few.

4. Complete examination and charting is done at the first regular appointment, as well as the beginning of the constructive work.

5. At the completion of each appointment, the next appointment is given, until all the work is completed or until the "essential" work is completed, according to the discretion of the dental officer in the light of the total needs of all the boys and the available time.

III. Recommendations.

(a) Fillings should take precedence over extractions because of the lasting value of fillings and the fact that boys on their own tend to have bad teeth extracted without urging more readily than to understand the need for having carious teeth filled in time.

(b) Relative values used in choosing work to be done are:

First and second molar fillings take precedence over others.

Cuspid and central incisor fillings come next.

Teeth that occlude take precedence over those that do not.

Teeth with a lesser number of carious surfaces are treated first, so that more teeth are preserved in the limited time available.

(c) Boys anxious to have fillings made should be given precedence. These men will continue to care for their teeth through life and hence more lasting good will come of work done for them.

(d) Each boy should be taught the necessity for daily brushing and semiannual prophylaxis and examination.

(e) No ordinary prophylaxes are performed. The boy can wait for cleaning of the teeth until he gets home with less harm than if he were to wait for a filling.

(f) No root-canal work is done. Time is better employed in saving vital teeth.

(g) No gold, plastic or porcelain (baked) materials are used, no inlays, crown, bridgework or dentures of any kind.

(h) The preferred filling materials are all American Dental Association approved.

1. Amalgam (silver).

2. Porcelain synthetic for anterior fillings.

(i) Use of the x-rays is urged wherever necessary.

(j) A boy may be trained as a dental assistant.

Duties:

Make appointments and mark time slips.

Sterilize instruments and assist at the chair.

Care for office and equipment maintenance.

A PALATOPOGRAPH FOR CONTOUR MAPPING OF THE PALATE

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INTRODUCTION

SEVERAL means by which the linear dimensions and shape of the hard palate can be ascertained have been described in the dental literature. For the most part, these methods have made use of instruments for computing height, width and length at certain points.

Maller[1] devised a palatometer consisting of a calibrated crossbar supporting a graduated vertical shaft which slides horizontally on the crossbar. The vertical shaft carries a movable sounding rod, which is used to make soundings of the palate in the midline and in transverse section at the mesiobuccal cusps of the first molars. These readings are transferred to correspondingly placed perpendiculars on a chart, thus revealing the profiles and dimensions of the palate in sagittal and coronal sections.

Stanton, Fish and Ashley[2] describe a plotter and dental pantograph which projects dimensional readings of the palate on a plane surface for correlation with dimensional readings taken with a cephalometer.

Sedwick and Brawley[3] describe a forceps-type palatometer for direct measurements of the length, width and height of the palate.

Investigators in the field of experimental phonetics have had reason to attempt to show graphically the relationship of the shape of the palate to the areas of linguapalatal contact during articulate speech. Among these is a method described by Russell,[4] who devised a procedure for perforating at 1 cm. intervals a baseplate model of the palate. When held against a light source so that the perforations can be projected on a translucent plane surface, the spacing of the projected points gives an approximate indication of the degree and direction of slope of the palatal arch.

Although the methods described above provide accurate information as to certain dimensional measurements of the palate, they do not provide a true representation of the general configuration of the palate, and give only fragmentary data on the degree and direction of slope of all parts of the palatal arch. Judgment of palate form requires a great amount of interpretation from the data which these methods can furnish.

This article presents a new method for obtaining linear measurements and for revealing shape by means of contour drawings in depth relationship. The instrument designed and constructed for this purpose, which is called a palatopograph, is herein described. It was constructed for the University of Michigan Speech Clinic in 1941 by Mr. Alex Pentland under my supervision.

DESCRIPTION

The palatopograph consists of two operating mechanisms, one for orienting and holding a plaster dental cast of the maxillodental arch and palate, and the other for discovering and recording the perimeter of the palate at given planes.

The fixture for orienting and holding the cast is constructed and mounted as shown in Figures 1, 3 and 4 (E). Orientation of the cast is accomplished with

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reference to three locating pins, an anterior fixed pin, Figure 1 (A), and two adjustable pins (B) mounted on a rigid frame, which stands above the dental surface of the inverted cast (D). The anterior pin is placed in the midline. The two adjustable pins are placed laterally and are set in small blocks with a slide-and-lock mechanism (C) which makes possible a considerable range of movement of the pins in all directions of to any desirable position for the purpose of maintaining a balanced pressure under the cast. The entire mechanism is mounted on a wooden base (H).

The recording mechanism consists of a surface plate, Figure 1 (G), on which is moved a surface gage, Figure 2, (K). Connected to the gage is a parallelogram, Figure 4, (M), which operates a writing stylus (N). The essentials of construction of the parallelogram are

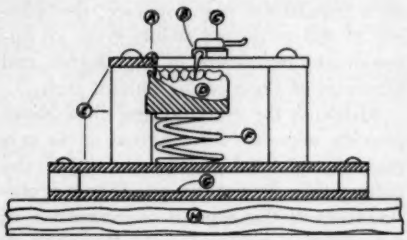

Fig. 1.—Section view of cast holding fixture.

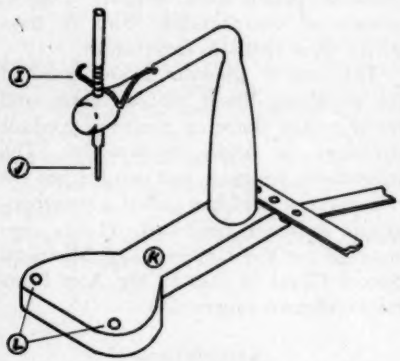

Fig. 2.—View of surface gage and discovering stylus.

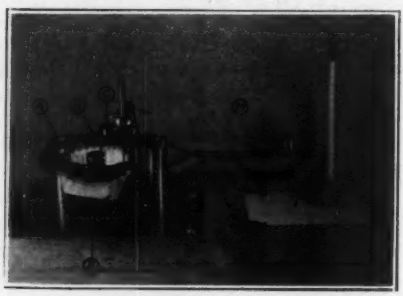

Fig. 3.—Front view of palatopograph.

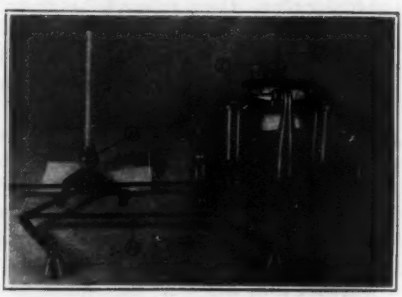

Fig. 4.—Back view of palatopograph, showing construction of parallelogram.

the horizontal plane while the orientation points are being determined. A turn of the locks fixes the locating pins solidly in place after orientation has been established. The cast is held in firm contact with the locating pins by a strong spring (F) placed between the base of the cast and the base of the fixture. The spring is free so that it may be moved as shown in the photograph. The relationship of the discovering stylus (J) and the writing stylus is always a constant 1:1 ratio at any point in their range of movement and their movements are always parallel. The surface gage, resting on three ball-bearings in contact with the surface plate (two are shown in Figure 2 [L] and one, not indicated in the drawing, is at the rear of the gage) is freely movable in any direc-

tion within a circumscribed area which considerably exceeds that of the dental cast.

The discovering stylus is grooved at intervals of 2.5 mm. and is vertically adjustable to any of these levels. The stylus is held firmly in place at any given level by a strong spring lock (I), which may be released by the operator when he desires to select a new level. The intervals are spaced from a zero reference level in the same plane as that of the tips of the three locating points. The movements of the discovering stylus at any given level will be recorded directly by the corresponding movements of the writing stylus over paper fixed in place by small spring clips.

Fig. 5.—Palatopogram (trapezoid conformation) showing gingival crest in dotted line and perimeters of levels of palate at intervals of 2.5 mm. as indicated. The height from the gingival crest to the top of the arch is approximately 16.25 mm.

OPERATION

Operation of the machine is simple. The cast is slid into place over the supporting spring and is oriented so that the anterior fixed locating point touches the lingual gingival tissue between the central incisors. The two lateral movable pins are adjusted to make contact at the midpoint of the lingual gingival tissue of the first permanent molars and are locked in place. The cast is thus rendered immovable except to strong pressure, and constant reference points are assured for this and all subsequent measurements.

The surface gage is then moved into place with the discovering stylus directly over the cast and the stylus is set at zero level. The tracing can be begun at any point on the palatal surface of the cast, of course, but it has been found convenient to start at a point located by the lingual groove of the second molar, following the periphery of the plane at zero level around to the lingual groove

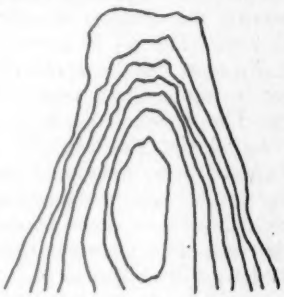

Fig. 6.—Palatopogram (triangular conformation).

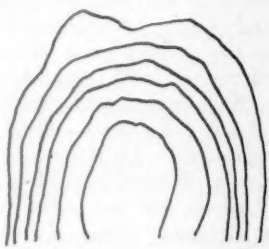

Fig. 7.—Palatopogram (ovoid conformation).

of the second molar on the opposite side of the cast. Movement of the surface gage is accomplished most smoothly by a two-handed operation, one hand guiding the gage so that the stylus is kept in light contact with the cast, the other hand assisting the movement of the writing stylus. Tracing of the next level, 2.5 mm. below the zero plane, is accomplished by lowering the discover-

ing stylus to the desired level and tracing the periphery of the cast at that level, as indicated above. As the operator proceeds in this way to the lowest traceable level of the cast, the contours can be accurately drawn, as shown in Figure 5.

The interpretation of the configuration thus obtained, which is similar to the reading of a geographic contour map, can be facilitated by the use of numbers marking in millimeters the distance relationships of the levels in the same way that topographic maps of terrestial surface indicate the distance above or below sea level. (Fig. 5.) Degree of slope in any direction can be accurately determined by noting the proximity of the tracings. The closely spaced lines indicate an abrupt decline; the more widely spaced ones, a gradual slope.

Palate height can be measured approximately, with an error of at most somewhat less than 2.5 mm. Height is computed from the formula.

$$h = 2.5n - 1.25$$

in which n is the number of contour lines, and 1.25 is a corrective allowance for the average error in instances in which the last level cannot be traced by the discovering stylus. Width and length at any given place can be accurately measured from the tracings. By the use of a planimeter and the appropriate formula for computing volume from an average of plane areas, a fairly accurate determination of volume can be achieved.

In making and interpreting these drawings, it should be kept in mind that the discovering stylus at zero level does not always reveal the outline of the gingival margin, because the level of the margin may vary considerably at different points. If an indication of this outline is desired, it will be necessary to set the discovering stylus at a level above zero and to move it in a path adjudged to be parallel to the gingival margin. This line on the drawing can be distinguished from the other tracings by color difference or by a dash line as indicated in Figure 5.

As one could easily predict before comparison of the tracings from different palatal casts, the patterns are highly individual and vary widely in dimensions and slope. The patterns are probably as highly individualized as finger prints. Figures 5, 6 and 7 present palatopograms which illustrate the widely divergent types of palate form that may be encountered. These particular tracings were selected as typical of their class according to the ratio of anterior and lateral slopes, and according to the resemblances of the general configuration to an ovoid, trapezoid or triangular pattern. A tentative classification has already been determined on the basis of these relationships.[5] Palates presenting a high degree of irregularity can be graphically shown with considerable accuracy.

The palatopograph was originally designed and constructed to facilitate the study of linguopalatal contacts in speech. It is expected, however, that it will have uses in other types of investigation in which recordings of palatal form and dimensions are needed.

SUMMARY

The palatopograph is an instrument by which contour drawings are produced to illustrate the shape and dimensions of the palate. Sample palatopograms of widely divergent palatal shapes show the patterns that can be produced by direct tracings from carefully made plaster casts.

BIBLIOGRAPHY

1. MALLER, J. W.: New Simplified, Photographic Technic for Determining Relationship of Teeth, Palate and Occlusal Plane to Face and Cranium in Living Subjects. *Internat. J. Orthodontia*, 16:972-981, September 1930.

2. STANTON, F. L.; FISH, G. D., and ASHLEY-MONTAGU, M. F.: Description of Three Instruments for Use in Orthodontic and

Cephalometric Investigations (with Some Remarks on Map Construction). *J. D. Res.*, 11: 885-902, December 1931.

3. SEDWICK, H. J., and BRAWLEY, R. E.: Palatometer. *Am. J. Orthodontics*, 24:673-674, July 1938.

4. RUSSELL, G. O.: The Vowel. Columbus: Ohio State University Press, 1928, pp. 337-339.

5. CRANE, E., and RAMSTRUM, G.: Classification of Palates. Master's Thesis, May 1942.

A STUDY OF COLORATION OF TEETH IN ACRYLICS

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FROM the time man first began to create images of those things that he saw about him, he had two difficulties to overcome: 1. A faithful imitation of an object in form only, such as a statue, left much to be desired. 2. Attempts to create outlines, as in paintings, in color only, made demands upon the imagination of the viewer to supply necessary contour and depth.

The creator of artificial teeth goes farthest in simulation of Nature, because he not only imitates form, but also, if he is equally successful in color, creates something that gives the greatest esthetic satisfaction, and the result is truly a work of art.

From dental school days on, we have acquired the dexterity and mechanical skill and equipment to faithfully copy any natural organ in contour. However, when we attempt to develop color, we are often forced to rely upon the highly developed skill of some one else or face the disheartening task of acquiring that skill ourselves.

Since the introduction of the blending acrylics for use by the technician, the greatest problem has been to secure a precise and definite method of color determination and blending. Each manufacturer has given us a series of arbitrary colors without apparent relationship, and a variance of color in each bottle supplied. A happy result is usually attained by a combination of fortuitous coincidences rather than by the use of a precise technic.

In an attempt to overcome the foregoing deficiencies, I undertook to develop a definite method of color determination and to reduce the results to fixed formulae.

Before proceeding, an understanding of the laws of color is essential. Color, a sensation produced in the eye, is caused by the reflection of light from or its passage through an object. Black is said to be a complete absence of color, and white the presence of all of the seven Newton's prismatic colors seen in the rainbow. Red, yellow and blue are called the primary colors, since, with their proper combination, any other desired color can be produced. The secondary colors, orange, green and violet, are combinations of two primary colors: red and yellow giving orange; blue and yellow, green; red and blue, violet. If the three primary colors are properly mixed, the resultant blend is a neutral gray, and, if deep enough, a black.

Color, for the purposes of description, is usually given three attributes: hue,

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which refers to the name, such as red, blue or yellow; saturation, which describes the amount of pure color contained, and brilliancy, which describes the amount of complementary or opposite colors in a color circle present, which causes a graying or toning down of the desired color. Tone, or tint, is used to denote variation from a darker to a lighter degree of the same color, and shade, to denote the passing from a lighter variation to a darker degree of the same color. These terms are often used interchangeably.

All six colors seen in the color spectrum are found in infinite variety in the natural teeth. To have a definite means of recognition of the most common varieties, a method of gaging them is essential. The porcelain tooth manufacturers have done this quite well in their many shade guides. All of them show the same basic colorations, differing only in distribution of the coloring in the teeth offered. A comparison of the old S. S. White, the new S. S. White, the 20th Century, New Trubyte, H. D. Justi & Son and Universal show the same duplications. They must, of necessity, as they are attempts at simulation of natural teeth. The newer color guides, such as New Hue, Verichrome, Vitalux and Meyerson, are unsuitable for our purposes, since the basic underlying color is covered by a diffusive and refractive layer of porcelain glaze. By careful grinding, this refractive layer may be removed, in order to display the basic tooth color.

On the basis of widest common usage, greatest range of color and distinctness of shadings, together with the fact that there could be found on some part of one of the tooth shade samples a match for any tooth color, the 20th Century Shade Guide was selected as the Standard.

This guide is first arranged for cervical shadings, from darkest to lightest:

The yellow sequences are as follows: First group: 11-14-17-15. Second group: 16-12-10-9-13. Third group: 7-3-6. Fourth group: 1-4-5-2-8.

The yellow-grayish brown sequence is: First group: 25-24-22-23. Second group: 19-18. Third group: 21-20.

This arrangement exhibits an extremely close gradation. Close examination will show that the range is actually within a few tones, so that the four yellow and three brown groups run the entire gamut. Each unit of its appropriate group is so close in coloring that, to an untrained eye, they appear to be the same. Any apparent difference between the shadings in any one group is caused by the proportionate bulk and the reflected coloration of the incisal portion. Therefore, these seven color formulae, all derived from two basic color blends, are not only feasible, but also will give the operator a match that will be esthetic to a high degree.

The tooth shade guide is now rearranged for incisal coloration. They are divided as follows from darkest to lightest:

1. Yellow grays: 25-(20, 21)-16-(7, 8)-(4, 5)-(1, 2).
2. Green grays: 17-19-13.
3. Blue grays: 18-12-3-10.
4. (a) Neutral grays: 9-6.
   (b) Pinkish grays: 15.
5. Brown grays; 14-11-(23, 24)-22.

Here again, we find five basic color blends which, with simple modification, can encompass the entire range of twenty-five colors. These steps will be considered later.

It can be seen, from all the above-mentioned groupings, that certain basic color combinations are present in all teeth. These are:

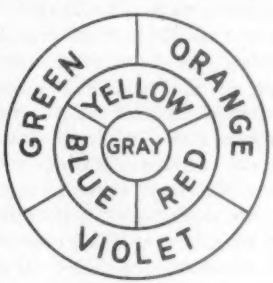
Basic color blends:
1. Grayish brown
2. Brownish yellow
3. Bluish gray
4. White

Modifying colors:
1. Spectrum yellow
2. Spectrum red
3. Spectrum blue
1. Clear (as a diluent)

Given these seven prepared colors, plus clear, in acrylic powder, the technician is equipped to match any possible color present in the mouth. If unusual, extreme characterizations are desired, the same colors can assure any result desired, when presented in a greater degree of saturation.

A study was instituted to determine which tooth colors were required, with the appropriate tone, to be made the basis for the new medium with which we are experimenting. In order to accomplish this, it was necessary to develop a colorimeter limited to the six color circle.

Pure tones of these colors were developed, and an entire series of acrylic tooth forms in graduated steps



Colorimeter.

was made, running from several shades darker than any that could be found on any shadeguide, to a tone so light as barely to permit a discernment of the basic color. This was done on a definite mathematical basis, so that it was possible to reproduce each and every color tone at will. It was found that a 5 per cent variation was indiscernible by the untrained eye; and that 10 per cent deviation was just sufficiently marked to give a smooth reduction in saturation and still enable the untrained eye to detect the variation.

It was found necessary to employ pure hues, as any slightly blended color had a tendency to confuse the resultant blends with other colors. Examination of these tone ranges revealed such a gradual "letdown" with white from pure color to an off-white that it became easy by direct comparison with the shade sample to determine the percentage of color. The darkest of each pure color that could possibly be found on any shade guide having been determined by comparison, and an allowance of one extra step made for possible exceptions, that shade was then selected as the 100 per cent color. "Letdowns" with white were then made in acrylic samples by 10 per cent steps, so that a proper series of each color was developed. It was found also that a variation of the percentage of pigment contained in the clear acrylic made a decided difference in the color. A simple demonstration of this is made by placing one drop of blue ink in a tumbler of water. Adding a second drop will not change the color, but will intensify the first variation, because it presents a greater volume or saturation of the color in the solution and, to the average eye, the hue will naturally appear more pronounced or darker. Greater opacity also creates a difference in tone, as we then perceive only the solid reflected color and gain or lose little owing to light diffusion and refraction. However, too great an opacity leads to a dead appearance. It is therefore advisable to use a greater opacity in body shades and more translucency in incisal shades.

A difference in depth of cross-section also caused an apparent change, due to the same phenomena, of a greater volume of color. This can be demonstrated by a number of thin acrylic disks. The first one is no different from the last, but when one is superimposed on another, an apparent color change takes place.

An attempt was made to grade translucency by adding clear acrylic to the basic colors, but the only result was dilution of color, with the apparent lightening of tone. The colors white and gray were the only ones capable of this modification without a great change in

tone. As nearly all tooth enamel seems to present the same basic color, a light bluish gray iridescence which was sufficiently translucent to equal the average translucency of enamel was decided on. This, when placed as a glaze on the body of the tooth, assumes the tint of the underlying structure. Bluish gray was essential, since, owing to peculiar refractive phenomena of the pigment and clear acrylic, a neutral gray has a tendency to assume a greenish cast.

Another difficulty to overcome was the translation of color from one medium to another; i.e., tooth color to porcelain to acrylic. A blue dye may be a perfect match as to color, but when it is placed in silk or cotton, the color will appear quite different. If much work is to be done by the technician, it is advisable for him to select one guide for use in comparing colors, to avoid variation from guide to guide, or better, to create for himself a color guide in acrylic.

In matching tooth color, the color sample should be placed next to the tooth in the mouth and both viewed from every angle from a distance of at least 2 feet. North daylight is best, because it is fairly constant in actinic strength. Artificial light, equipped with proper blue filters to eliminate the excess yellow rays, is also quite suitable. One of the best, in my experience, is the use of a photo-enlarging opal glass bulb No. 212, made by Mazda. This light approaches a pure white. Color matches made under this lamp stand up well when compared in daylight.

The colors to be matched should be viewed both dry and wet, as there will be a variation in color, due to diffusion and refraction. One should never look constantly at colors to be matched as the eye tires rapidly and is then unable to differentiate color variations accurately. After a quick glance, one should look away. Ten-second cycles are about correct. Another condition to be guarded against is the tendency of acrylics to become chameleonic, by absorption and reflection of the surrounding environment. This accounts for those pleasing blends in the mouth, which are so far off color outside. A particularly accurate method of color matchings is the observation of a color match through gelatin filters, such as are made by the Defender-Photo Supply Co. The set known as the "Varigam" Filters, Nos. 1, 3, 5, 7 and 10, will instantly show deviation when interposed before the eye.

Having obtained the desired match of the tooth colors, and made a chart of their locations on the tooth, we proceed with the blending of the colored acrylic to achieve the desired result. Let us attempt to see how a scientific blending formula should operate. We have a tooth which falls in the incisal color yellow-gray-4th group. It should be possible to take a basic color blend to match the darkest tooth in that classification and, toning this down with white, have a match of the particular group into which the desired color falls. Fortunately, this method does comply so closely that we are able to obtain the desired result with little difficulty. Those teeth that do deviate are easily brought into line with a slight modification. For example, I am able to match twelve colors, all derived from one basic blend, with simple modification. A second basic blend is easily converted into eight colors, and the remaining five (of the 20th Century Guide) are derived from the third blend. The cervical colors are all derived from two basic blends.

Proportioning percentages, if arrived at by the usual volumetric method, are wasteful of materials and inaccurate. To overcome this and enable the technician to gage his materials accurately, the gravimetric method is advised. This is done by a simple proportional weighing balance that, by means of a shifting fulcrum, enables any minute quantity to be used as unity, and the other desired elements are then exactly proportioned to meet the required blending formula with precision and speed.

In blending, one of the common causes

of variation in color is the fact that the incorporated pigment is a mechanical mixture, suspended in a mass of clear acrylic, like a mixture of sand and gravel. On vibration, this gradually segregates and settles to the bottom of the container. Before the bottle is opened to withdraw any colored material, the latter should be thoroughly reincorporated by vigorous shaking to redistribute the pigment evenly.

Another cause of color fading is the action of the monomer. If a large quantity is used instead of just enough to saturate the mass, there will be a mechanical washing or leeching of the pigment from the mixed mass and the result is a faded imitation of the desired color. Also, since the particles of the blended pigments are of different specific gravity, separation by flotation takes place, and the eye perceives a different tone because the reflecting light does not strike the entire mixture.

Color is also affected by the size of the color particles and the clear acrylic powder. If all the particles are so small that the eye does not readily recognize the separate units, the result is a smooth appearance. That is why we sometimes see speckled acrylic "porcelains."

The greatest promise of color control lies in the manufacturer's ability to integrate the color in the body of each particle of the clear material, and then to pulverize so finely that, when two or more powders are mixed, a smooth mixture results as with the silicate cements.

Acrylics of this type have been produced experimentally and show great promise. The greatest problem is the mechanical reduction of the powder to impalpable fineness, as it has a tendency to weld together under the grinding pressure. This processing has a final result of greater translucency. Because of small interstices in the condensed powder, there is less tendency to the inclusion of moisture, air bubbles or monomer vaporization bubbles. A smaller quantity of monomer liquid is absorbed and shrinkage is minimized thereby.

The present type of colored acrylic, when processed, shows, when examined under magnification, a mosaic of clear acrylic particles each surrounded by a layer of pigment suspended in the polymerized monomer that filled the interstices of the powdered element. It is the passage of light through them that gives the solid-color appearance. We are unable to differentiate among the various colors and receive the impression of a new blend because the pigment that is dusted on each globule of clear acrylic is intimately mixed with that of the added polymer when blended, and the pigments appear as if mixed separately and then incorporated in the clear powder. Of course, if a large quantity of clear acrylic is added, the appearance of translucency is gained.

One of the commonest causes of change of color is the use of an opaque cement such as oxyphosphate of zinc under an acrylic jacket or inlay. This operates in two ways: (1) by reflection of the color of the cementing medium, through the translucent acrylic (coming through as a blend of the cement color and the selected color), and (2) by virtue of the opacity, preventing the passage of light through the acrylic. In addition, there is the influence of the color of the dentin upon the result. The cure lies in the development of a transparent cement. The closest approach at present is a semi-silicate cement such as "kryptex." A color should be selected as nearly as possible the color of the restoration medium.

Foods also cause a variation in color, because of a tendency to excrete sulfides in the saliva. This fact often reacts with the pigment of the acrylic color, to form new chemical compounds. In some cases, enough of the sulfide is present to turn the color to a dark brown. In compounding pigments, it was found necessary to develop a group that were not only chemically compatible, but also were not affected by the action of the acrylic monomer or by the temperature used in curing, or that were easily affected by

hydrogen sulfide or faded under light.

Cementing media should never have any silver or copper salts incorporated for antiseptic purposes, as these will stain the tooth tissue and reflect through the restoration medium.

Opaque substances are used to coat solid metal surfaces embedded in acrylics to prevent them from reflecting through. A coating of paint made of oxyphosphate powder of tooth color and liquid monomer on a metal surface will give a more nearly correct color reflection and the color will blend perfectly with that of the superimposed acrylic. Its effect is much the same as when opaque porcelain is used under the overlying translucent porcelains in jacket crowns. Some interesting effects are created by using such a monomer paint with pure pigments just under a glaze of clear acrylic, a naturalness of characterization resulting that is startling. It does call for great care in blending and manipulation as the color effects are extremely intense.

One unexpected difficulty with the acrylic powder at times was an apparent repulsion of the pigment particles, with a deviation from the desired tone. Some of the pigments were found to be less affected than others by this phenomenon. If a small amount of the correct pigment is added, the repulsion seems to vanish. It is my belief that this is due to static electrical charges on the separate particles of acrylic powder. More extensive research will be made on this point.

I have purposely avoided any discussion of technic in processing, as that is a subject too broad to be included in this article. The foregoing should give the reader a better understanding of the peculiarities of acrylics and, therefore, enable him to avoid the pitfalls and achieve the results that he desires. I hope that it will lead the profession to demand from the manufacturer those products that are essential to his work, for plastics are here to stay.

Station Hospital.

CAST DOWEL RETENTION

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THE use of pins has long been accepted as a most potent adjunct of retention in inlays and abutment restorations. The presence of one or more of these pins within the confines of the cavity outline and parallel to the line of insertion will greatly enhance the retention of any restoration.

The usual procedure for such restorations is the manipulation of wrought pins, either in the impression for the indirect procedure or in the wax pattern for the direct procedure, and casting of the inlay thereto. Wrought pins or wires that snugly fit prepared holes require absolute parallelism. Casting against these pins offers another problem and one that has caused great difficulty.

However, for those who follow the indirect method, it is possible to obtain an accurate reproduction of a tapered pinhole at the same time and with the same modeling compound that is used for the cavity impression. It is also possible to obtain from this impression a die, then a wax pattern and finally a casting of the entire restoration, including dowels, in one piece. By the use of tapered fissure burs, holes are produced in which the dowels or counter parts will go to place even with considerable discrepancies in parallelism between pins and the cavity

alinement. When seated, such castings offer a maximum of frictional retention.

The schematic diagram (Fig. 1) illustrates the extent of deviation from parallelism between two holes that will still permit a casting made thereon to go to place. When tapered holes are used, the line of preparation of one hole does not need to be parallel to the line of preparation of another hole, but only parallel to any line between its tapered walls. From the diagram, it is obvious that we are eliminating in a very positive way one of the factors that have been a source of worry to many operators; i.e., parallelism.

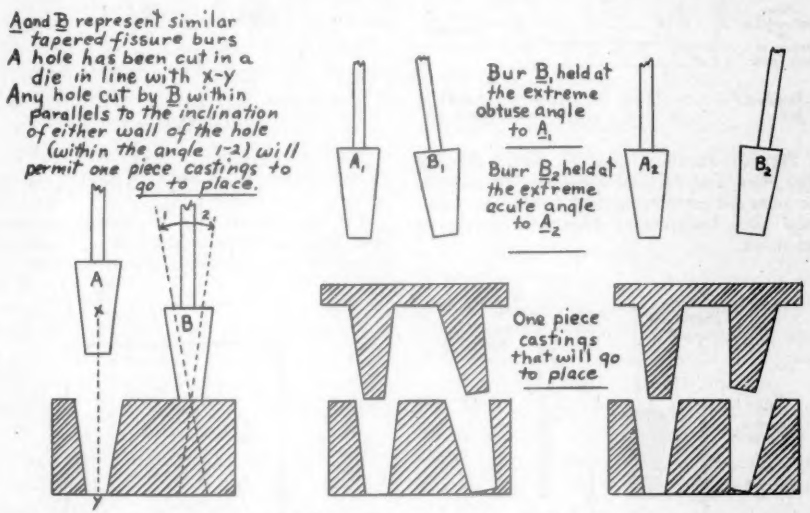
A and B represent similar tapered fissure burs
A hole has been cut in a die in line with x-y
Any hole cut by B within parallels to the inclination of either wall of the hole (within the angle 1-2) will permit one piece castings to go to place.
A
B
x
y
1
2
A1
B1
Bur B1 held at the extreme obtuse angle to A1
Burr B2 held at the extreme acute angle to A2
A2
B2
One piece castings that will go to place

Fig. 1.—Diagram illustrating possible extremes in line of preparation of tapered holes that will permit castings made thereon to go to place.

In posterior teeth, the outline form, the general depth and the extent of the possible cavity will be determined by previous mutilation. (Fig. 2.) In a general way, parallel axial walls at nearly right angles to the pulpal and gingival walls with extension for prevention of decay or cuspal fracture are basic requirements. The repeated use of a lead pencil to blacken the surfaces being prepared will outline the area of preparation and reveal undercuts. At one or more points within this cavity outline that will permit the use of a pin, without jeopardizing the vitality of the pulp, the dowel holes are prepared. These holes should be started in a flat area as near the boundaries of the cavity as possible, first with a No. 1 round, then a No. 701 tapered fissure bur, to a depth of 1 mm. By repetition of this procedure, the holes may be deepened and enlarged to 2, 3, or more millimeters as the case requires.

Figure 3 illustrates a simple inlay cavity to which dowel retention has been added, thus greatly increasing retention. Such modified inlays can be used as conservative bridge abutments especially with broken stress assembly.

For dowel construction on anterior teeth presenting the palatal inclined surface, a flat seat is first established with the end of a small tapered stone. (Fig. 4.) With a No. ½ round bur on this seat, a hole is cut to a depth of approximately 1 mm. as nearly as possible parallel to

the line of cavity preparation. With a No. 700 tapered fissure bur at the opening, it will be possible to follow this hole to its depth. The procedure is repeated first with the ½ and then with the 700 tapered fissure bur to a depth of 2 or

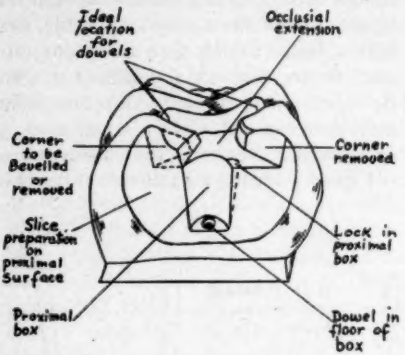

Fig. 2.—Proximal view of molar showing slice, box and occlusal extension. Corner to be removed permitting lock groove in proximal box. Location of dowels for maximum retention.

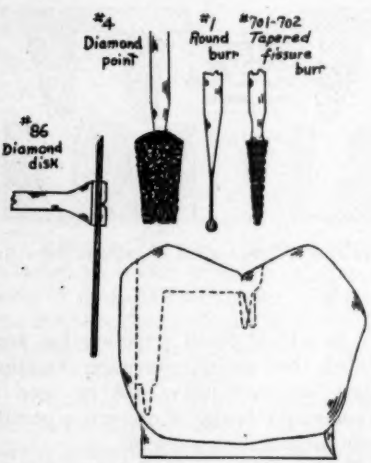

Fig. 3.—Buccal view of molar showing proximal slice, box, occlusal extension and location of dowels.

even 3 mm. and the opening is enlarged with a 701 tapered fissure to completion. With a properly fitted copper band, a snap impression should be taken as the cutting of the hole proceeds, to check the alinement. Faults will show themselves

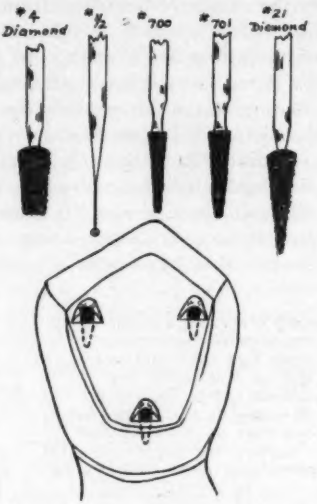

Fig. 4.—Palatal view of anterior preparation with flat seats established at convenient points for preparation of dowel retention.

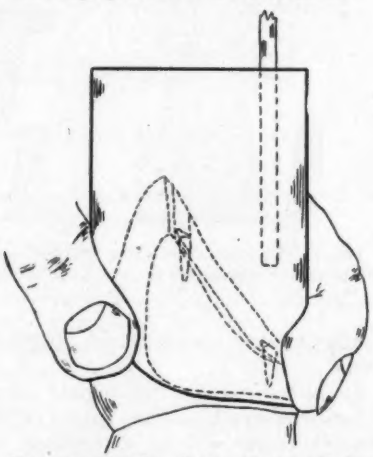

Fig. 5.—Tightly fitting, festooned band firmly held at the cervical aspect while compound is packed into dowel holes with the blunt end of an instrument.

as compound drags and may be corrected before the hole is carried to greater depths. It is unwise and may be dis-

astrous to cut holes to their desired depth without checking their alinement with snap or trial impressions as the cutting proceeds.

When more than one dowel is to be used, it is advisable to select for preparation first the hole most accessible and continue by steps as outlined to completion. Proceed then with the next most accessible. An old tapered bur waxed to the first prepared hole can serve as an indicator for alinement in preparing a second hole. Careful observation of the alinement of the handpiece will aid in establishing parallelism, as the bur is carried first from the finished hole to the one under the preparation. To a careful operator, any extreme angulation beyond the permissible errors of alinement is so obvious as to be almost impossible.

Impressions are obtained by using a snugly fitting copper band, unannealed, shaped to the tooth and trimmed in outline to just cover the cavity on the prepared surfaces and to follow the height of contour on the unprepared surfaces. (Fig. 5.) This outline can be corrected if the snap impressions show a coverage anywhere greater than 1 mm. beyond the preparation area or the height of convexity. The band is filled with compound, thoroughly softened; the surface to contact the tooth is slightly lubricated, and the band is pressed to place. By alternately pressing the band and the compound, a slight excess of material is kept ahead of the band as it goes to place. When seated as prepared, the band is securely held in place and, with a small blunt instrument through the open end of the band, the compound is forced, by packing, into the prepared dowel and packing completed with finger pressure. The band must be sufficiently tight and securely held at the cervical border to confine the pressure applied over the dowel holes.

All such impression procedures must be confined to a clean tooth, one free of caries and saliva, as the possibility of forcing infected material into the exposed dental tubuli by pressure on the compound must not be overlooked.

Impressions thus obtained and packed with a good laboratory amalgam will produce accurate dies of all prepared surfaces and all dowel holes. It is then possible, with this master die, to wax up, cast and finish the restoration (including the dowels) in a one-piece casting.

The use of hard golds even in bridge prosthesis is a procedure that is not only unnecessary, but also of questionable value. Soft golds offer greater frictional grip, are more easily manipulated, respond to the forces of mastication and are sufficiently strong. A hard gold under a blow will spring and will transmit the force throughout the mass. Repeated blows on a hard gold will check facings and the seal of cementation. Soft gold, on the other hand, absorbs the force of the blow at the point of contact and under repeated attacks will flow. Any force that is great enough to distort a medium soft gold of reasonable thickness is greater than the abutments or restoration should be expected to withstand.

These auxiliary cast dowels are ideal not only for extensive restorations, but also for simple and conservative preparations. They reinforce inlay retention sufficiently to warrant their use as bridge abutments.

53 Bay State Road.

A METHOD FOR ROUTINE ISOLATION AND CULTIVATION OF THE SMALLER ORAL TREPONEMES

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THE oral bacteria constitute one of the most interesting bacterial flora of the body, yet little is known concerning their cultural characteristics, classification and rôle in oral and in systemic disease. Of the bacteria comprising this group, the spirochetes have presented the greatest difficulty, from a technical consideration, in isolation and maintenance in artificial media. The constant association of *Borrelia vincenti* and the small oral treponemes with fusospirochetal infections has aroused considerable interest in the cultivation of these organisms, but consideration of the problem has met with little success. Of the oral spirochetes, the small tightly coiled organism referred to as *Treponema microdentium* has been isolated on several occasions, but this has been found to be a tedious and time-consuming task. If we are to understand the relationship of the oral spirochetes and associated organisms to the so-called fusospirochetal infections, it is necessary that methods be developed whereby routine cultures of these organisms may be made with the least possible difficulty, for animal experimental work.

In general, most methods used in the past for the isolation of the oral treponemes are modifications and adaptations of principles advocated by Noguchi.[1, 2] The methods employed, with the exception of those advocated by Wichelhausen[3] and Ecker and Weed[4] depend on the ability of the spirochetes to penetrate a suitable medium and grow away from the contaminants. The most difficult phase of the work was found to lie in obtaining pure subcultures from the highly contaminated primary cultures contained in test tubes. The small surface area of the agar column was invariably contaminated by bacteria spreading over the free surface from the central stab canal. This was further complicated by disruption of the medium by gas-forming bacteria, with subsequent contamination of the slits produced in the medium. More recently, Rosebury[5] advocated small petri plates as containers for primary cultures; a decided improvement over the test-tube method, inoculation being accomplished with a straight wire by a stab 2 mm. obliquely through the wall of a well previously prepared in a suitable agar medium. It is the purpose of this paper to report a successful method for routine isolation and mass cultivation of the smaller oral spirochetes with reference to types of culture media and enriching substances employed.

TECHNIC AND MEDIA

The technic employed in these experiments utilized 25-cc. beakers, approximately 3.5 cm. in diameter and 5 cm. in length for primary cultures. The beaker mouths were covered with wrapping paper and fastened in place with string. After sterilization, the excess paper was

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trimmed so that a one-half inch border extended below the rim of the beaker. The string was replaced by a small rubber band, which facilitated removal of the paper cap for inoculation procedures and observation. Approximately 12 cc. of an agar medium was used in each container, which gave a depth of about 17 mm. After the medium had solidified, a well was prepared in the center of the layer of agar to a depth of about 12 mm. This was accomplished by the use of a pipet drawn out of soft glass tubing to form a thin-walled tip about 4-5 mm. in diameter, the sides of which were paralleled and sharpened with the aid of a carborundum oil stone. A 1 cc. rubber bulb attached to the opposite end of the pipet facilitated removal of the agar plug.

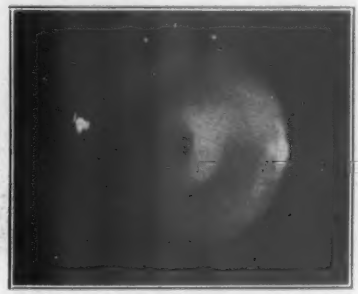

Fig. 1.—Five-day-old primary culture of small oral treponemes obtained from case of Vincent's infection.

After the use of many types of solid media, it was found that the veal heart-agar advocated by Proske and Sayers[6] and, more recently, by Rosebury and Foley,[5] which is essentially a modification of Huntoon's agar,[7] was applicable to the growth of some of the smaller treponemes. Proske and Sayers[6] substituted veal heart for beef heart and increased the agar concentration from 1.6 to 1.8 per cent. During the course of the present experiments, it was found more advantageous to lower the agar concentration to 1.2 per cent and "thiopeptone" was substituted for "bactopeptone." As recommended by Huntoon,[7] final clearing of the medium was accomplished by centrifugation immediately after the last sterilization period, while the solution was still hot. The resulting clear medium was dispensed in 100-cc. screw-top bottles and stored at room temperature, without apparent change in growth-promoting qualities. This medium served as an agar base, which was further enriched at the time of its use by the addition of 1 cc. of ascitic fluid and 1 cc. of a 1 per cent solution of neutralized cysteine hydrochloride. (The cysteine solution may be sterilized by passage through a Berkefeld N filter. Immediately before use, the solution is neutralized by adding 0.05 cc. of a 5 normal solution of sodium hydroxide. The exact neutralization of the cysteine hydrochloride is not particularly essential. The use of unneutralized samples has had comparable results, both in primary cultures and in transfers.) A fluid medium for mass cultivation of pure cultures of treponemes was prepared in the same manner as the solid agar base, with the exception that the agar concentration was reduced to 0.2 per cent. Ascitic fluid and neutralized cysteine were used in the same proportions as for primary cultures.

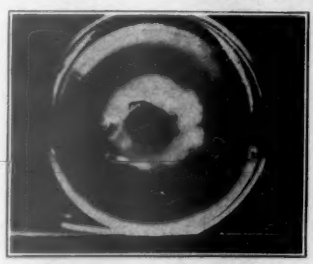

Fig. 2.—Five-day-old primary culture of small oral treponemes obtained from case of canine black tongue. Darkfield examination of these organisms revealed morphologic characteristics similar to those of T. microdentium.

All specimens of ascitic fluid were not suitable for this work, particularly those samples that contained bile. The fluid was collected under aseptic conditions,

but occasional batches became contaminated. This was remedied by passage through a Berkefeld filter. All specimens of fluid were tested for growth-promoting qualities by inoculating samples with scrapings obtained from cases of Vincent's infection or pyorrhea alveolaris and incubated anaerobically at 37°C. for three or four days. If, at the end of this period, large numbers of spirochetes were found by darkfield examination in association with other oral contaminants,

Fig. 3.—Thirty-six-hour-old initial pure subculture of treponemes obtained from case shown in Figure 2.

the ascitic fluid was acceptable for use. Some samples were not satisfactory when freshly obtained. However, when stored in the refrigerator for several months, these proved to be satisfactory. This finding is in agreement with that of Kast and Kolmer.[8]

In this study, the material for primary isolation of spirochetes was gingival scrapings from human cases of Vincent's infection and pyorrhea alveolaris, and swabbings obtained from the sublingual and buccal mucosa in cases of black tongue in dogs. This material was emulsified in approximately 0.5 cc. of the fluid medium containing 0.2 per cent agar, to which ascitic fluid and cysteine had been previously added. Enough of the scrapings was used to assure a heavy suspension, which was then examined under darkfield illumination to establish the presence of spirochetes. By means of a capillary pipet, several drops of the emulsified inoculum was introduced into the well previously cut in the enriched agar medium. (Extreme care should be exercised to prevent the inoculum from

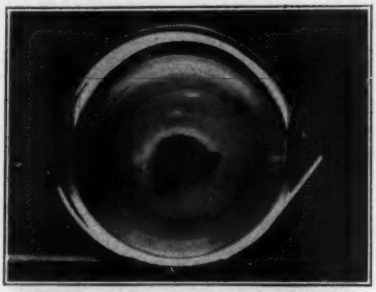

Fig. 4.—Three-day-old primary culture of oral treponemes from case of canine black tongue. These organisms resembled T. mactodentium morphologically on darkfield examination.

coming in contact with the free surface of the medium. This is usually due to one of two things: accidental dropping of the contaminated material on the free surface during the inoculation procedure or overflow of the contents of the well onto the free surface due to weeping of the agar. The former may be prevented by exercising more care in the manipulation of the inoculating pipet; the latter, by preparing the well an hour or more prior to inoculation so that the fluid formed within the well by syneresis may be pipeted off prior to inoculation.) The beakers were then placed in an upright

position in jars rendered anaerobic with hydrogen, catalyzed by electrically heated platinized asbestos coils, and incubated at 37°C.

The medium employed for subculturing procedures, which was the same as that used for primary isolation, was dispensed in 5-cc. amounts into 12.5 by 1.5 cm. test tubes. Before subcultures were made, a small amount of spirochete-infiltrated agar was removed for dark-field examination. Whether the spirochete-containing agar was for dark-field examination or for transfer, it was removed as far from the well as possible. This was accomplished with a capillary pipet having a 1-cc. rubber bulb attached.

In subculturing procedures, the inoculum-containing pipet was introduced into the desired medium about 5 mm., and a slight positive pressure applied to the bulb to maintain the position of the inoculum within the pipet tip when conveyed to the bottom of the agar column. The contents were then expelled by exerting an increasing positive pressure upon the rubber bulb while simultaneously withdrawing the pipet along the long axis of the tube. This procedure prevented the trapping of air bubbles or the splitting of the agar column by sudden forceful expulsion of air.

RESULTS

The first indication of spirochetal growth in primary cultures became apparent in as short a time as twenty-four hours and not more than forty-eight hours. These primary cultures were ready for subculturing in from three to seven days, an average of five days being the rule. Such initial cultures had a characteristic appearance, which was evidenced in one of two ways: as a delicate white haze extending outward from the reservoir corresponding with the depth of the inoculum and imparting a "fuzzy" appearance to the walls of the highly contaminated well, or as condensed nodules appearing along the sides of the well. In the latter case, the nodules gradually increased in size and ultimately produced the characteristic haze associated with spirochetal growth, so that the end-result in the two instances was similar. Two 5-day-old primary cultures are shown in Figure 1.

As can be seen in Figure 1, the con-

Fig. 5.—Three twenty-four-hour-old initial pure subcultures obtained from case shown in Figure 4.

taminating organisms are limited to the confines of the well; whereas the treponemes proliferate and infiltrate the surrounding agar medium and grow in an ever-widening zone beneath the sterile surface. The treponemes were obtained free of contamination by simply removing a plug of spirochetal infiltrated agar with a capillary pipet as far from the well as possible. By this method, as many as twenty pure subcultures have been obtained from a single primary plate.

It was found advantageous to obtain the inoculum as far from the contaminating organisms as possible. The utilization of spirochetes in the proximity of the contaminants has the disadvantage of requiring more care in securing the inoculum and also a greater chance of impure subcultures, which were not infrequent. In this experiment, the treponemes obtained from near the well did not exhibit any more viability than those removed from the periphery of the spirochetal haze. This observation was confirmed by darkfield examination, using motility as an indication of viability, and also by the time required to obtain comparable growth in subculture. In the latter case, pure subcultures were obtained routinely in as short a period as from thirty-six to seventy-two hours and never more than five days. Such results are not in agreement with those of Rosebury and Foley,[5] who advocate obtaining the spirochetal infiltrated agar as close to the contaminants as possible because they are supposedly more viable. A possible explanation of this difference of opinion may be that there is a higher fluid content of the agar in the region of the reservoir, the result of the proteoclastic activity of the contaminants. Such a condition would permit more freedom of motion of the treponemes when observed by darkfield examination. When spirochetes were removed from the periphery of the haze, it was found that they exhibited as much motility as their fellow organisms in association with contaminants when suspended in a fluid menstruum and liberated from the agar in which they were embedded.

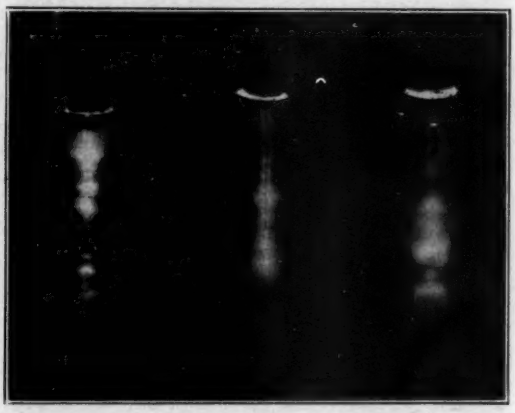

Fig. 6.—Three fifty-eight-hour-old pure subcultures obtained from 3½-month-old stock culture.

The same procedures were applied successfully in isolating four strains of small oral spirochetes from as many cases of black tongue in dogs. Pure cultures were obtained in periods ranging from four to five and one-half days. Of this group of organisms, three strains were found to be morphologically similar to *T. macrodentium* and the other re-

sembled *T. microdentium*, both of which have been described by Noguchi[1] in cultures obtained from human material. Figure 2 represents 5-day-old primary cultures, and Figure 3, a 36-hour-old initial pure subculture of the strain resembling *T. microdentium*. The growth in the primary plate is dense and cloudy in appearance and sharply demarcated from the surrounding medium. The same appearance is maintained in the subculture. Figure 4 is an example of a 3-day-old primary plate of one of the strains morphologically similar to *T. macrodentium*. The growth in this instance is more delicate in consistency and is also sharply demarcated from the medium. Figure 5 shows three 24-hour-old initial subcultures obtained from the preceding plate.

All stock strains were carried in the solid medium, used for primary cultures and subcultures. Those organisms obtained from human sources were carried for periods up to three and one-half months in anaerobic jars at 37°C. without transferral. Darkfield examination and subsequent transfer proved the viability of such strains. As an example, Figure 6 represents three 58-hour-old pure cultures that were transferred from a stock culture that was 3½ months old. The viability of the organisms is exemplified by the large amount of growth obtained in such a short time. Apparently, such long intervals between transfers were not detrimental to the treponemes. However, in contrast to the human strains, it was found that the organisms obtained from cases of black tongue in dogs required transferral every two or three weeks.

The effectiveness of this technic is exemplified by the short time required for obtaining primary growths, and the large numbers of initial pure subcultures that can be obtained from a single plate. The use of a well in primary plates is a decided improvement over the older methods of inoculating a suitable medium by stabbing with a capillary pipet or straight wire. The well is capable of holding a larger amount of a concentrated inoculum than could be had by either of the stab methods. Consequently, larger numbers of spirochetes are held within the confines of a highly nutritious medium; which permits rapid multiplication and penetration of the agar. This condition is apparently a factor in materially re-

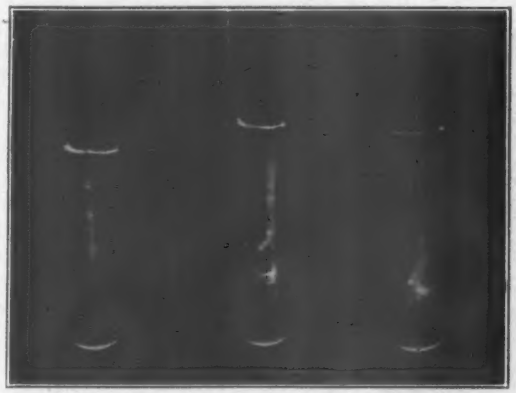

Fig. 7.—Three thirty-six-hour-old initial pure subcultures obtained from 3-months-old primary culture, which demonstrates effectiveness of well, used in primary plates, for restricting contaminants to immediate vicinity even after long intervals of time.

ducing the time required for primary isolation of the treponemes. The wall of the well serves as a filter through which the spirochetes may penetrate and become isolated from the contaminants. Successful initial subcultures have been obtained from 3-month-old primary plates. This demonstrates the effectiveness of the well in restricting the contaminants to its immediate vicinity. Figure 7 represents three 36-hour-old pure subcultures obtained from such primary plates. In addition, it has not been found necessary to rush transferral procedures and to place subcultures immediately under anaerobiosis as has been advocated.[5] Primary plates, as well as pure

Fig. 8.—Five-day-old subculture in which regular yeast extract was used as enriching substance.

cultures, have been exposed to air at room temperature for intervals ranging from two to twenty-four hours without apparent ill-effects or undue time in subsequently obtaining pure cultures.

Several types of culture media have been utilized in an attempt to cultivate the oral treponemes. The type of tissue used in the preparation of the media has a direct effect upon the success and time required to obtain positive growths. Media prepared from heart tissue have proved more successful than those prepared from any other type of animal tissue. In general, autoclaved infusion agars have been found unsatisfactory. However, media prepared according to Huntoon's method[7] proved much more satisfactory. In such cases, the highest temperature was obtained by the use of the Arnold sterilizer. According to Huntoon,[7] certain growth-promoting "hormones" are extracted in the presence of a colloidal solution of agar and the resulting medium is as good as an average grade serum agar. Several types of tissue including human heart and placenta were used in an attempt to find a better substitute for veal heart as advocated by Proske and Sayers.[7] The results obtained in primary cultures and subcultures are shown in the accompanying table. The veal heart medium was found superior to the other types of media in respect to the time required for primary isolation and cultivation of the small oral spirochetes, as well as the quantity of growth obtained. Occasional batches of veal heart medium possessed sufficient growth-promoting qualities to assure that pure cultures of spirochetes could be maintained even without the addition of ascitic fluid or cysteine hydrochloride.

Various percentages of agar were used in the preparation of the media. It was found that a concentration ranging between 1 and 1.4 per cent was most efficacious. In these experiments, a 1.2 per cent agar was used routinely. However, when 1 cc. of ascitic fluid and 1 cc. of a neutralized cysteine hydrochloride solution were added to 10 cc. of the medium, the concentration was lowered to approximately 1 per cent. The lower agar content favored the production of wider zones of growth in shorter periods of time. When the agar concentration was below 1 per cent, the fluid content was such that the inoculum within the well spilled over, owing to weeping of the agar, which resulted in contamination of the free surface. Under these conditions,

it was impossible to remove plugs of spirochete-infiltrated agar free of contamination. However, these lower agar concentrations were found very favorable for cultivation of pure strains of treponemes. In this respect, 0.2 per cent agar was found most efficacious. Neutralized eral types of enriching substances were utilized; namely, ascitic fluid, rabbit and sheep serum, serum ultrafiltrate[5, 9] with and without phenol red, yeast extract, regular and fortified (Fleischmann), and biotin. With the exception of biotin, the substances were used in amounts varying

Growth of oral Treponemes in relation to the tissues and methods used in the preparation of the media.

*TISSUE USED IN PREPARATION OF MEDIA	AUTOCLAVED INFUSION AGAR		PREPARED ACCORDING TO HUNTOON'S METHOD	
	PRIMARY CULTURE	SUB-CULTURE	PRIMARY CULTURE	SUB-CULTURE
Horse muscle	0	0	+	+
Beef muscle	0	0	+	+
Rabbit muscle	+	+	+++	+++
Beef heart	++	++	+++	+++
Spoiled veal heart	—	—	+++	+++
Veal heart	++	++	++++	++++
Human heart	—	—	++	++
Placenta	—	—	+	+
Spoiled horse muscle	0	0	+	+
Pig heart	+	+	—	—
Veal liver	0	0	0	0

0, No growth
+, Slight growth
++, Fair growth
+++, Good growth
++++, Excellent growth
— , Not tried

*In the preparation of the media concetrations of 1% thio-peptone, 0.5% salt and 1.2% agar were maintained. In all cases the reaction was adjusted to pH 7.4 and 1cc. each of ascitic fluid and cysteine hydrochloride were added to 10cc. of the agar base.

cysteine and ascitic fluid were added in the same proportions as in the solid medium. The use of large quantities of medium, from 50 to 100 cc., in Erlenmeyer flasks, was found to be very effective for mass cultivation of such organisms.

During the course of experiments, sev- from 1 to 3.5 cc. of the enriching substance to 10 cc. of medium. When higher concentrations of enriching fluids were utilized, the percentage of agar was proportionally increased so that the resulting agar content was approximately 1 per cent. It was found that 1 cc. of these substances in 10 cc. of medium was suffi-

cient for both primary cultures and subcultures. In all cases, neutralized cysteine hydrochloride was used in a concentration of 0.1 per cent in place of the usual kidney or testicular tissue advocated by Noguchi.[1] This substance was first advocated by Hosaya[10] for the cultivation of anaerobic bacilli. More recently, it has been utilized by Kast and Kolmer[8] and Wichelhausen[3] for the cultivation of spirochetes. The cysteine definitely enhances the growth of the treponemes, and more than do fragments of animal tissue. It probably serves as a nutritive substance in addition to lowering the oxidation reduction potential of the medium.[10]

Of the group of enriching substances, it was found that average grades of ascitic fluid were more efficacious in producing wide zones of growth and in shorter periods of time. On the other hand, rabbit serum, sheep serum and serum ultrafiltrate (with phenol red) produced growths of comparable nature, as to both amount and time required to secure such cultures. The ultrafiltrate without phenol red was apparently better than that with the dye and was definitely superior to the sheep or rabbit serum.

The yeast extract was prepared from dehydrated material by adding 5 gm. to 100 cc. of distilled water and boiling for fifteen minutes. The resulting mixture was centrifuged and the supernatant removed and autoclaved, and 1 cc. of this material was added to 10 cc. of the veal heart medium. When the regular or fortified extract was used in primary cultures and subcultures instead of ascitic fluid, extremely wide zones of growth were occasionally obtained which were comparable with that of ascitic fluid. However, the results were inconsistent and could not be relied upon for routine work. Figure 8 is a photograph of a 5-day-old subculture in which regular yeast extract was used as an enriching substance.

Biotin was also used in place of ascitic fluid. Various dilutions ranging from 0.1 to 1 cc. of a 0.001 per cent solution were added to 10 cc. of medium. The results in primary culture were uniformly negative. However, an occasional positive culture was obtained when pure cultures were utilized.

SUMMARY

A method is presented for the routine isolation and cultivation of the small oral treponemes. The technic is based on the use of a well for holding a large amount of concentrated inoculum in the confines of a highly nutritious medium of low agar concentration, which favors rapid multiplication and penetration of the medium by the spirochetes. This fact is apparently responsible for materially reducing the time required for primary isolation of such organisms. The wall of the well serves as a filter through which the spirochetes may grow and become isolated from the contaminants. The possibility of splitting of the agar by troublesome gas-forming bacteria is extremely remote as they remain in the confines of the well and the gas formed escapes harmlessly into the container. Transfers can be made by removing a plug of spirochete-infiltrated agar through the free sterile surface by means of a capillary pipet. This technic has been applied successfully in the routine isolation of the small oral treponemes from human cases of Vincent's infection and pyorrhea alveolaris and in black tongue in dogs.

BIBLIOGRAPHY

1. NOGUCHI, HIDEYO: Cultural Studies on Mouth Spirochetes (Treponema Microdentium and Macrodentium). *J. Exper. Med.*, 15:81, January 1912.

2. Idem: Treponema Mucosum (New Species), a Mucin Producing Spirocheta from Pyorrhea Alveolaris, Grown in Pure Culture. *J. Exper. Med.*, 16:194, 1912.

3. WICHELHAUSEN, R. H.: Cultivation and Isolation of Mouth Spirochetes. *J. Bact.*, 43: 65, January 1942.

4. ECKER, E. E., and WEED, L. A.: Purification of Cultures of Treponema Microden-

tium by Centrifugation. *J. Infect. Dis.*, 49: 355, October 1931.

5. ROSEBURY, THEODOR, and FOLEY, GENEVIEVE: Isolation and Pure Cultivation of Smaller Mouth Spirochetes by Improved Method. *Proc. Soc. Exper. Biol. & Med.*, 47: 368, June 1941.

6. PROSKE, H. D., and SAYERS, R. R.: Pulmonary Infection and Pneumoconiosis. I. Bacteriologic and Experimental Study. *Pub. Health Rep.*, 49:839, July 20, 1934.

7. HUNTOON, F. M.: "Hormone" Medium. Simple Medium Employable as Substitute for Serum Medium. *J. Infect. Dis.*, 23:169, August 1918.

8. KAST, C. C., and KOLMER, J. A.: Methods for Isolation and Cultivation of Treponemes, with Special Reference to Culture Media. *Am. J. Syph., Gonor. & Ven. Dis.*, 24: 671, November 1940.

9. SIMMS, H. S., and STILLMAN, N. P.: Substances Affecting Adult Tissue in Vitro. III. Stimulant ("A Factor") in Serum Ultra Filtrate Involved in Overcoming Adult Tissue Dormancy. *J. Gen. Physiol.*, 20:649, May 1937.

10. HOSAYA, S.: New Method for Cultivation of Anaerobic Bacilli. *Sc. Rep. Govt. Inst. of Infect. Dis., Tokyo*, 4:103, 1925.

MORPHOLOGY AND INCIDENCE OF SECONDARY DENTIN IN HUMAN TEETH

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INTRODUCTION

THE changes that occur in the structure and in the distribution of dentin is a problem of interest not only in the study of histology, but to clinical dentistry as well. This is particularly true in regard to the variety of this tissue usually referred to as secondary dentin. Despite the completion of several excellent studies dealing with this topic, our knowledge regarding the prevalence and formation of secondary dentin and the various conditions which may influence its formation is, at least from a quantitative standpoint, controversial, incomplete or lacking entirely.

Reich[1,2] made an extensive study of the occurrence and varieties of secondary dentin in human teeth. He differentiates between primary and secondary dentin in the normal tooth on the basis of regularity and number of dentinal tubules per unit of area. He maintains that this tissue forms during the period in which the tooth is in function, and accordingly calls this the dentin of the "functional period." Hopewell-Smith,[3] in discussing secondary dentin, classifies this tissue as (1) physiologic, which originates, he asserts, as the result of aging and abrasion of the tooth, and (2) adventitious, the result of caries or erosion. The experimental evidence of Fish,[4,5] however, indicates that secondary dentin does not always form in response to caries, but, when it does, the morphologic variety of secondary dentin that is deposited is dependent on the nature of the initial injury to which the dentinal tubules are subjected, and not on the potential capacity of the tooth to produce a calcified tissue.

Beust, [6] who also made a study of the dentin of carious teeth, maintains that secondary dentin is laid down in teeth with deep caries, but rarely in teeth in which the caries is shallow. He notes further that sclerosis of the dentinal tubules usually occurs as a result of caries of the dentin. Morphologic changes as-

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sociated with abrasion have also been described by Bodecker.[7] Bunting and Hill,[8] in discussing the formation of secondary dentin, maintain that different individuals exhibit reactions which vary in response to similar irritating conditions. They also assert that secondary dentin is rarely observed in deciduous teeth. The investigations of Ireland,[9] on the other hand, clearly indicate that secondary dentin does form in deciduous teeth. The experiments of Gurley and Van Huysen,[10,11] designed to test some factors in the formation of secondary dentin, are also of interest in connection with this general topic.

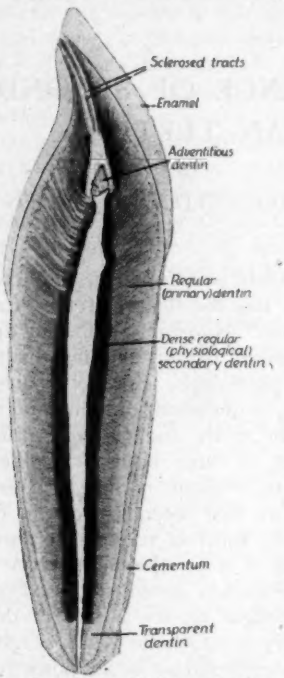

Fig. 1.—Permanent incisor, showing variations in structure of dentin. (Ground section.)

Fig. 2.—Permanent premolar showing carious lesion, sclerosed dentin and absence of secondary adventitious dentin. (Ground section.)

PROBLEM

In this study, we are interested primarily (1) in comparing our observations in reference to the morphology and incidence of secondary dentin in permanent and deciduous specimens with those previously reported in the literature, for which purpose the specimens were divided into (a) intact, (b) untreated carious and (c) amalgam-filled carious teeth, and (2) in examining sufficient numbers of teeth in each group selected to enable us to express our data in a semiquantitative manner. We believe that, as a result of our studies, we have arrived at a better understanding of the structure and relative incidence of secondary dentin in human teeth than has heretofore been possible.

MATERIALS AND METHODS

The teeth examined in this study consisted of specimens from routine extractions. No selection of the material was made in reference to the age of the teeth (except to differentiate between

permanent and deciduous) or the reason for extraction. In this one respect, therefore, our specimens consist of a random sample of extracted teeth. Approximately 300 specimens were studied and arranged in the following groups: (1) intact teeth, (2) untreated carious teeth, (3) carious teeth in which amalgam had been placed.

The specimens that were carious and those having amalgam restorations were

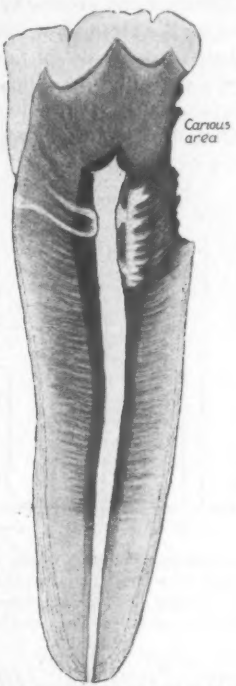

Fig. 3.—Premolar showing caries, marked sclerosis of circumpulpal dentin and pulpal plug of secondary adventitious dentin.

sectioned through the center of these regions. Only those specimens in which the dentinal tubules could be traced from the periphery of the dentin to the pulp chamber were retained for study. In the amalgam groups, an attempt was made to select those teeth that gave no evidence of secondary decay.

The depth of the dental caries was determined in each carious tooth, each lesion being classified as shallow, medium or deep. For this purpose, we consider involvement of the peripheral third of the dentin as shallow, of the peripheral two-thirds as medium and of more than the peripheral two-thirds and pulp exposure as deep.

The teeth were sectioned on an abrasive wheel and the sections were mounted in water and examined by both transmitted and reflected light. By mounting the sections in water, we were able to avoid the optical artefacts that frequently appear in dentin when this calcified tissue is mounted in the ordinary media.

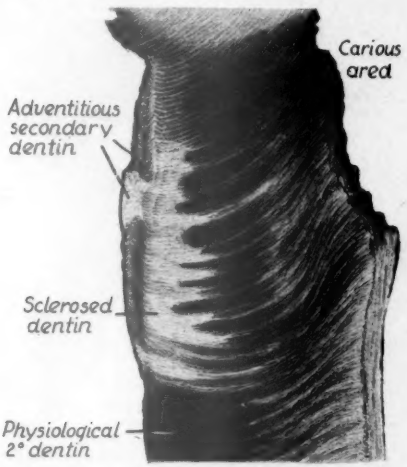

Fig. 4.—Detail of carious area and secondary adventitious dentin from tooth shown in Figure 4. (Ground section.)

MORPHOLOGY

1. *Intact Permanent Teeth.*—The morphologic appearance of dentin of the intact adult tooth is fairly well exemplified by the specimen shown in Figure 1. Most of the dentin is of the regular (primary) variety, in which the matrix is semi-opaque and the tubules regularly arranged. The apical part of the tooth usually consists of dentin that is more transparent than that which is present

in the coronal region and is often referred to as transparent dentin.

In this specimen, we can also observe a number of opaque and transparent (sclerosed) tracts leading from the abraded incisal surface to the coronal limit of the pulp horn. The coronal portion of the pulp horn in this specimen is filled with a modified variety of dentin (secondary) in which the matrix is hyaline and the tubules are irregular and few. The sclerosis of the tracts and the formation of the dentin in the pulp horn are generally believed to be due to exposure of dentin in the process of the abrasion to which the tooth is subjected. Additional variations in the structure of dentin, such as Tomes' granular layer and interglobular zones, are also represented. We wish to emphasize, however, the well-defined circumpulpal zone, which is characteristic of all the human adult teeth that we have examined. It is the dentin that makes up this zone which we shall designate as physiologic secondary dentin. When a section of a tooth is examined under low magnification, the most striking characteristic of this tissue in the greater part of the tooth is its opaque appearance. When the tissue in this zone is examined at a reasonably high magnification, we are able to differentiate the following varieties: (a) dense, in which the matrix appears opaque and the tubules arranged with varying degrees of regularity, and (b) transparent, in which the matrix appears hyaline and the tubules are irregularly arranged and are few or lacking entirely. Using the tooth shown in Figure 1 as a rough composite of a normal adult tooth, we can now compare the dentin that occurs in such a tooth with that in other teeth in which we are interested.

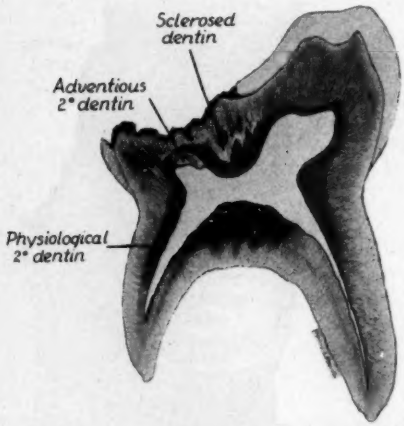

Fig. 5.—Typical deciduous carious molar showing relation of carious dentin, sclerosed areas and adventitious dentin. The circumpulpal zone is also very prominent. (Ground section.)

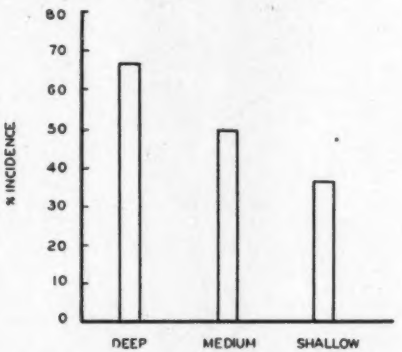

Fig. 6.—Relation between depth of cavity and incidence of secondary adventitious dentin. The sample examined consisted of ninety-eight permanent carious teeth.

2. *Carious Permanent Teeth.*—We next examined a series of carious teeth, in order to ascertain the structure of the dentin in these specimens. All the teeth examined show the definite circumscribed zone of physiologic secondary dentin adjacent to the pulp cavity. Furthermore, in every tooth, we note a considerable amount of sclerosed transparent dentin underlying or adjacent to the carious dentin. (Fig. 2.) Aside from the disintegration of the carious dentin itself, this was the only change in struc-

ture of the dentin that could be recognized in some of the carious samples. In others, however, an additional variation appeared, as shown in Figure 3, consisting of an adventitious or pulpal projection of dentin. The dentinal tubules that are in contact with this area pulpally are continuous peripherally with the carious dentin. We shall refer to this pulpal plug that is associated with caries of the dentin as adventitious secondary dentin.

Reference to Figure 4, a detailed view of this typical condition, reveals the carious dentin, the partially sclerosed physiologic zone and the adventitious plug composed of several varieties of secondary dentin. The morphologic varieties of adventitious dentin observed in the several specimens that we examined appear to be similar to those observed in the circumpulpal zone in normal intact teeth.

3. *Amalgam Restorations.*—The series of teeth in which amalgam restorations had been made were, in respect to the structure of the dentin, qualitatively like the group of untreated carious teeth just described. Sclerosis of the dentin occurred in all of the teeth. In some, adventitious dentin was present; in others, it was not.

4. *Deciduous Teeth.*—The group of deciduous teeth that we examined consisted of intact and carious specimens and there were also some amalgam restorations. In reference to the structure of the dentin in this group, we again note the same qualitative picture observed in the other groups. One of the typical deciduous molars in the series that we examined is represented in Figure 5.

ANALYSIS OF MORPHOLOGIC VARIATIONS WITH SPECIAL REFERENCE TO THE INCIDENCE OF ADVENTITIOUS SECONDARY DENTIN

The morpohologic findings reported in the preceding paragraphs, which were recorded for the entire group of specimens examined, have been arranged to illustrate several correlations in graphic form. We are particularly interested in the incidence of adventitious secondary dentin in the several groups of teeth that we have studied in reference to the following topics:

1. *Incidence in Total Sample of Permanent Carious Teeth.*—If we consider the incidence of adventitious secondary dentin for the whole group of approximately 100 permanent carious teeth, we find that 54 per cent of the group show this tissue, while 46 per

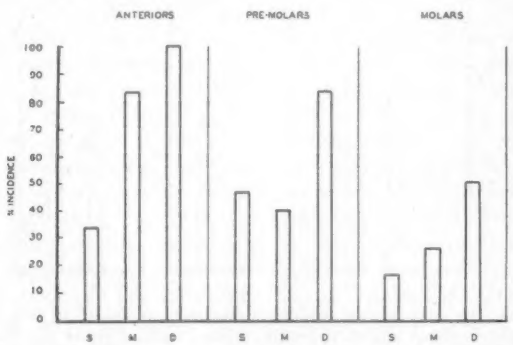

Fig. 7.—Comparison of incidence of secondary adventitious dentin in relation to different types of teeth. This graph was constructed from data obtained in examining twenty-six anterior teeth, thirty premolars and forty molars. S, M and D, shallow, medium and deep caries.

cent do not. While these percentages are correct for the total sample, we obtain a totally different concept of the relative incidence of this tissue in carious teeth when we differentiate between the depth of caries in the several teeth examined.

2. *Depth of Cavity.*—As previously described, the carious lesions were arbitrarily divided into three classes: shallow, medium and deep. In Figure 6, which is concerned with untreated permanent carious teeth, we have illustrated the frequency or number of carious teeth that have adventitious secondary dentin in the three groups examined. These samples consist of twenty-five shallow, thirty-four medium, and thirty-eight deep lesions. As shown in this chart, the incidence of adventitious secondary dentin for the total in each group of shallow, medium and deep carious amounts to 36, 50 and 68 per cent, respectively. Comparing the incidence in the three classes, we find that for deep, medium and shallow lesions, we obtain a ratio of 2:1.4:1 for the three groups, respectively. In other words, one finds adventitious secondary dentin occurring twice as frequently in teeth with deep carious lesions as in those with shallow lesions.

3. *Incidence in Anterior Teeth, Premolars and Molars.*—We next compared the incidence of adventitious secondary dentin in the permanent untreated carious teeth in reference to the anatomic position that they occupy in the jaw, dividing the teeth for this purpose into three groups. The data assembled in this analysis are graphically represented in Figure 7. Examination of this chart shows that of the three samples examined, which consist of twenty-six anterior teeth, thirty premolars and forty molars, the highest incidence occurs in the anterior teeth; the premolars are somewhat intermediate in position, and the molars have an incidence consistently lower for shallow, medium and deep caries than either the anterior or the premolar group.

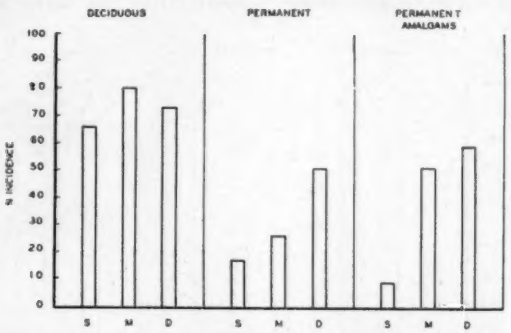

Fig. 8—Comparison of incidence of secondary adventitious dentin in fifty deciduous molars, forty permanent carious molars and forty amalgam-filled molars. S, M and D, shallow, medium and deep caries.

4. *Incidence in Molars Having Amalgam Restorations and in Deciduous Molars, and a Comparison Between These and Untreated Permanent Carious Molars.*—Having established the facts (a) that adventitious secondary dentin is most prevalent in teeth with deep carious lesions, and (b) that, in untreated permanent molars, there is a lower incidence of this tissue than in either anterior teeth or premolars, we next determined the incidence of adventitious dentin in carious deciduous molars and permanent amalgam-filled molars. The samples, which are represented in Figure 8, consist of fifty deciduous, forty permanent

and forty-five amalgam-filled permanent molars. Reference to this chart shows that the deciduous carious molars have a consistently higher incidence, regardless of depth of cavity, than either of the permanent molar groups.

The second comparison that we wish to point out is the similarity between the two groups of permanent teeth consisting of untreated molars and the amalgam-filled molars. In consideration of the fact that the comparison is made in relation to the depth of the cavity, reference to Figure 8 shows that the amalgam-filled teeth do not present significantly higher ratios than the untreated specimens.

DISCUSSION

It was previously pointed out that a considerable difference of opinion exists in regard to many questions relating to secondary dentin. One of the contributing factors in this situation is the use of conflicting terminology.

In regard to the morphologic varieties of dentin that we were able to differentiate in the several teeth which we examined, we agree in the main with Reich.[1, 2] Our observations in regard to the zone of circumpulpal dentin incline us to favor the term physiologic secondary dentin as proposed by Hopewell-Smith, for the following reasons: It is present in all adult teeth and is not the result of any external force or environmental influence. Furthermore, we know that dentin continues to grow slowly, and apparently as long as the pulp tissue remains intact.

Our basic morphologic findings are similar to those of Bodecker[7] in regard to the effect of abrasion, and also to those of Beust[6] in regard to the sclerosis of dentin and the formation of adventitious secondary dentin in deep caries of the dentin. Our observations are also in agreement in a qualitative sense with those of Fish[4, 5] in regard to his contention that caries or injury does not always produce secondary dentin. Our data, furthermore, confirm the observation of Ireland[9] in regard to the formation of secondary dentin in deciduous teeth. In this respect, our results are at variance with the statement of Bunting and Hill.[8] The experiments of Gurley and Van Huysen,[11] while reasonably clear-cut in most respects, do not take into account the presence of a circumpulpal zone of secondary dentin and thus fail to distinguish between physiologic and adventitious secondary dentin. This omission, we feel, may lead to erroneous conclusions in studies dealing with the rate of formation of secondary dentin.

Our studies show that there is a consistent zone of circumpulpal (physiologic) dentin in all mature human teeth. The matrix and tubules of this zone of dentin are usually less uniform in appearance than the peripheral (primary) dentin. We were unable, however, to distinguish any difference between the structure of physiologic secondary dentin produced in normal intact teeth and adventitious secondary dentin observed in teeth with carious lesions.

Examination of our data shows that in an unselected group of permanent carious teeth, 56 per cent of the total sample reveal the presence of adventitious secondary dentin, while 46 per cent do not. The second significant correlation which we observe from our data is that adventitious dentin is present more frequently in anterior teeth than in molars.

In tests to determine the relation between depth of cavity and the incidence of this tissue, we note that it develops more frequently in deep caries than in shallow caries. The anterior teeth having deep caries, for example, have an incidence of 100 per cent, while those having shallow lesions have an incidence of only 33 per cent. A similar ratio is also observed in the molars. In regard to the latter, our results are in fairly

close agreement with those of Beust.[6]

A comparison of the data assembled on the permanent molars, amalgam-filled molars and the deciduous molars shows (1) that adventitious secondary dentin occurs in deciduous teeth as previously shown by Ireland,[9] and (2) that it occurred more frequently in the sample that we examined than it does in corresponding permanent teeth.

The series of permanent amalgam-filled molars that we examined are approximately similar to the untreated molars in respect to the relative incidence of secondary adventitious dentin. This observation is not what might be expected in view of the generally accepted belief that the usual procedures in cavity restoration tend to stimulate the formation of adventitious dentin.

The similarity of incidence in these two samples of teeth offers an opportunity for several speculations in regard to the formation of secondary dentin. We feel, however, that this phase of our study should be more nearly complete in some respects before any new hypotheses differing appreciably from those that now exist are proposed.

In all of the carious teeth that we examined, we invariably observed transparent (sclerosed) dentin so located in reference to the carious dentin that it appeared as a protective zone which, in effect, tends to wall off the carious from the non-carious dentin and the pulp. Sclerosis of dentin is then the first, and frequently the only, step in the apparent protective metamorphosis of dentin. Secondarily, adventitious dentin may be laid down, the probability of its occurrence being directly related to the increase in depth of the carious lesion.

SUMMARY

1. Carious teeth invariably show transparent (sclerosed) dentin adjacent to and underlying carious dentin.

2. Teeth with caries of the dentin may also show adventitious (pulpal) secondary dentin. The structure of this dentin is similar to that observed in the circumpulpal zone.

3. Our specimens show that adventitious secondary dentin occurs more frequently in anterior teeth than in molars. Further, there appears to be a direct relation between the incidence of adventitious secondary dentin and the depth of caries of the dentin.

4. Deciduous carious specimens have a higher ratio of adventitious secondary dentin than have permanent carious teeth. Permanent amalgam-filled specimens were observed to have an incidence not appreciably higher than untreated permanent teeth.

BIBLIOGRAPHY

1. REICH, P.: Das Irregulare Dentin der Gebrauchsperiod. Jena: Gustav Fischer, 1907, pp. 57.

2. *Idem:* Einiges uber das "Irregulare" Dentin vorlaufige Bemerkungen zur Kritik desselben. *Osterr.-ung Vrtljschr. Zahnheilk,* 24:83-99. 1908.

3. HOPEWELL-SMITH, ARTHUR: Normal and Pathological Histology of Mouth. Vols. 1 & 2. Philadelphia: P. Blakiston's Son & Co., pp. 345 and 347.

4. FISH, E. W.: Pathology of Dentin and Dental Pulp. *British D. J.,* 53:351, October 1, 1932.

5. *Idem:* Experimental Investigation of Enamel, Dentin and Dental Pulp. London: John Bale Sons & Danielsson, Ltd., 1933, p. 118.

6. BEUST, T. B.: Dental Histology and Embryology. Philadelphia: W. B. Saunders Co., 1934, p. 170.

7. BODECKER, C. F.: Consideration of Some Changes in Teeth from Youth to Old Age. *D. Cosmos,* 67:543, June 1925.

8. BUNTING, R. W., and HILL, T. J.: Text Book of Oral Pathology. Philadelphia: Lea & Febiger, 1940, p. 460.

9. IRELAND, R. L.: Secondary Dentin Formation of Deciduous Teeth. J.A.D.A., 28: 1626-1632, October 1941.

10. GURLEY, W. B., and VAN HUYSEN, GRANT: Histologic Changes in Teeth Due to Plastic Filling Materials. J.A.D.A., 24:1806-1817, November 1937.

11. *Idem:* Histologic Response of Teeth of Dogs to Operative Procedures. *J. D. Res.,* 24:179-192, April 1940.

477 First Avenue.

SURGICAL CONSIDERATION OF THE LATERAL PHARYNGEAL SPACE

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DESPITE the academic and practical importance of the lateral pharyngeal space, only infrequent references have been made to this surgical area in the literature. Roughly situated between the medial surface of the mandibular ramus and the lateral aspect of the pharyngeal musculature, this space is amenable to direct extension of inflammation from the posterior area of the mandibular body, to accidental invasion by the clumsily displaced impacted lower third molar and to retention of needle fragments broken during injection of the mandibular nerve. Its surgical import is thus augmented by three facts of strictly dental concern, identifying the area as one which the competent oral surgeon may enter with impunity.

The bony side wall of the lateral pharyngeal space is formed by the inner surface of the mandibular ramus and that portion of the inner surface of the mandibular body below and behind the third molar area. The medial, the posterior and a portion of the inferior aspects of the space are bounded by the internal pterygoid, a thick sheetlike muscle originating from the inner surface of the lateral pterygoid plate and part of the pyramidal process of the palatine bone and extending to its tendinous insertion along the inner surface of the back border of the ramus and inferior portion of the medial surface of the mandibular angle. The space, which is bounded above by the external pterygoid, which arises from the outer surface of the external pterygoid lamina, and a portion of the greater wing of the sphenoid bone, extends backward and outward to be inserted in the neck of the mandibular condyle and part of the articular disk of the temporomandibular joint.

The pharyngeal musculature from which the lateral pharyngeal space derives its name comprises fibers of the superior constrictor and middle constrictor muscles. The superior constrictor arises from the lower part of the internal pterygoid lamina, from the pterygomandibular ligament and from the alveolar process of the lower jaw adjacent to the attachment of the pterygomandibular ligament. The muscle curves backward to join the opposite muscle in the median pharyngeal raphe. The middle constrictor muscle has its origin in the stylomandibular ligament and the cornua of the hyoid bone and, like the superior constrictor, curves backward, overlapping the fibers of the superior constrictor muscle to join its fellow in the median pharyngeal raphe. Thus, these pharyngeal muscles form their respective portions of the boundaries of the lateral pharyngeal space. (Fig. 1.)

It will be noted that incomplete closure of the space by its muscular walls provides communication with the deep cervical fascia surrounding the carotid sheath. It is through this avenue that more serious extension may occur. Occasionally, such grave sequelae may terminate favorably, provided the enclosed pus burrows laterally to form a more superficial pool surrounding the sternocleidomastoid muscle, where evacuation is relatively simple. Otherwise, the fluid follows a downward course throughout

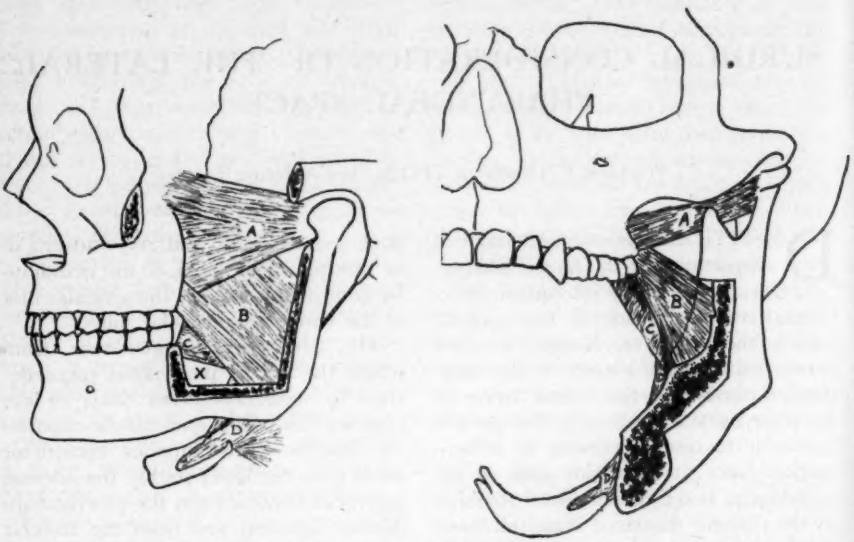

Fig. 1.—Musculature of lateral pharyngeal space, lateral and anterior view. A, external pterygoid muscle. B, internal pterygoid muscle. C, superior constrictor muscle of pharynx. D, middle constrictor muscle of pharynx. The cross in the lateral view indicates the point for incision for drainage. The interrupted line of the anterior view outlines the incision for surgical exploration of the area.

Fig. 2.—Incision for drainage for lateral pharyngeal space. The suction tip is ready for immediate disposal of the evacuated pus.

the deep fascial planes and may actually gain the mediastinum. It logically follows that complications of this nature should be under the management of a skilled general surgeon and that the operator who is qualified by dental training alone would be rash indeed to overstep his bounds.

Further observation of the musculature, as shown in Figure 1, will reveal that, from a lateral aspect, an unclosed area exists just anteriorly from the point where the middle constrictor muscle begins to overlap the superior constrictor, while, when viewed anteriorly, a similar space may be noted between the anterior border of the ramus and the

Fig. 3.—A, fragile bony balcony in which lower third molar frequently is situated. B, concavity of submaxillary fossa. C, lateral sweep of lingual cortical plate.

pterygomandibular ligament. These areas, covered only by mucous membrane, assume prime importance when the lateral pharyngeal space is to be surgically invaded.

Since many inflammatory processes involve both medical and surgical phases of treatment, inflammation of the lateral pharyngeal space requires the same dual concept. My remarks, however, will be confined to the surgical sphere and will concern, first, incision for drainage of the site and, second, the surgical avenue for exploration, as in the removal of a foreign body. The two phases will be considered in order.

Pyogenic involvement of the lateral pharyngeal space following removal of a lower third molar occurs by direct extension back and downward through the soft tissues on the medial surface of the mandible. Clinical symptoms, which are first noted about forty-eight to seventy-two hours after extraction, are characterized by a foul odor of the socket, moderate elevation of temperature, trismus, difficulty in deglutition and phonation and the patient's awareness of "a lump in the side of the throat." Objective signs include a medial displacement of the pharyngeal wall in the tonsillar region and a marked nasal twang of the voice, not unlike that elicited in acute peritonsillar abscess. External pressure beneath the angle is quite painful, while palpation reveals an exquisitely tender bulging area inside the mouth at a point about 1½ inches down and backward from the third molar socket. It is at this spot that incision is made for drainage when indicated by the clinical demonstration of frank pus beneath the mucosa, a region previously mentioned as one of the two areas of surgical importance owing to incomplete closure of the lateral pharyngeal space by the pharyngeal musculature.

Extreme trismus, which usually accompanies inflammation of the area, frequently dictates that the jaws be forcibly opened and that drainage be established under general anesthesia. Reasonable surgical judgment demands that adequate suction facilities be available for immediate use, since opening the jaws causes narrowing of the space and increases the pressure from the enclosed pus. This hypertension of the fluid may actually rupture the already weakened mucous membrane at the site of contemplated incision; while, in all cases, the danger of aspiration must be taken into account owing to the rapid escape of the pus.

Should rupture of the mucous mem-

brane not occur during opening of the mouth, surgical release is in order. A curved scalpel with its point directed laterally is carried to the point of incision. (Fig. 2.) Penetration of the blade through the mucosa is usually sufficient to establish drainage, although there is no objection to plunging the instrument to the medial surface of the mandibular angle. A small hemostat can be used to facilitate drainage of those cases if, owing to faulty clinical diagnosis, a simple incision does not effect complete evacuation of the contents. No drains or sutures are placed. Relief is immediate, and subsequent drainage is seldom necessary to complete recovery.

A foreign body in the lateral pharyngeal space is in virtually every case either a needle fragment broken during injection of the mandibular nerve or a lower impacted third molar radically displaced by the too vigorous application of mesial force. Backward displacement of the impacted tooth into the lateral pharyngeal space is invariably accomplished at the

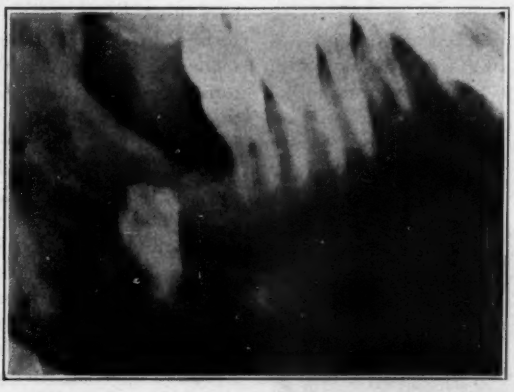

Fig. 4.—Foreign body in lateral pharyngeal space as disclosed by standard lateral jaw technic.

Fig. 5.—Identification of foreign body shown in Figure 4 with mandibular rami superimposed, showing true position of object.

expense of the fragile bony balcony which often surrounds the impacted tooth on its lingual, distal and inferior surfaces, and which is formed by the lateral sweep of the lingual cortical plate distally from the third molar and the concavity of the submaxillary fossa beneath it. (Fig. 3.)

Identification of the foreign body may be established roentgenographically by exposure according to standard lateral jaw technic. (Fig. 4.) Allowances must be made, however, for the incident angle of the rays striking the cassette. For more accurate representation, after the existence of the body has been confirmed, another view is made with the central rays vertical to the plane of the film, both rami being superimposed. (Fig. 5.)

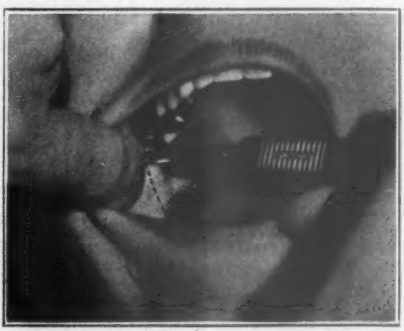

Fig. 6.—Incision down anterior border of ramus to gain surgical exploratory access to lateral pharngeal space.

While precise detail is obscured by the uninvolved ramus, the foreign body is shown in the true horizontal plane; a surgical requisite. Its position in the sagittal plane, while unnecessary, may be determined by an inferior-superior view.

Exploratory entry must not be made at the same site as incision for drainage owing to the necessarily small opening and the mechanically inadequate location of the latter. Fortunately, a site is available where an ample incision can be made with surgical safety. It has been stated that an incision can be made intraorally from the top of the coronoid process down the anterior border of the ramus without severance of any important nerve or vessel. It has been previously implied that this avenue offers complete access to the lateral pharyngeal space owing to its incomplete closure. Hence, a safe, practical approach is possible for the task at hand.

An incision is made down the anterior border of the ramus, not necessarily through the periosteum, to and throughout the retromolar triangle. (Fig. 6.) By blunt dissection through the underlying areolar connective tissue, the medial surface of the ramus is palpated back to the internal pterygoid muscle. With the incised area retracted medially, the remainder of the space is explored from its posterior aspect toward the front to preclude displacing the foreign body to an inaccessible area. Seizure and delivery can be made with any appropriate instrument. Local application of sulfanilamide powder before suturing the incision undoubtedly is an additional safety measure, although use of drains or packs is not advisable as such a procedure seems to enhance the foreign body reaction. In any event, extreme trismus is to be expected as a normal sequel to manipulation. Postoperative pain is usually mild.

SUMMARY

1. The lateral pharyngeal space has never been of dental interest.

2. It is within the prerogative of the competent oral surgeon to surgically invade the lateral pharyngeal space to establish drainage in inflammation following dental disease or to recover foreign bodies displaced during dental procedures.

3. Due regard for anatomic landmarks precludes inadvertent surgical damage.

4. Uncontrolled inflammation of the lateral pharyngeal space may result in grave involvement of the carotid layer of the deep cervical fascia.

5. The approach for drainage of the area is distinctly separate from that for surgical exploration.

6. Drainage is to be established only when adequate suction facilities are present, to avoid aspiration of pus and the subsequent danger of pulmonary disease.

7. The surgical approach for exploration of the lateral pharyngeal space, when carried out with good surgical judgment, is through an area devoid of any important vessels or nerves and can be made with impunity.

Medical Arts Building.

WHAT DOES THE LAYMAN KNOW ABOUT DENTAL HEALTH?

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FOR several years, we have been teaching dental health facts to laymen, notably to teachers, nurses and parents. It is natural that we should ask ourselves just how effective this teaching has been. How much of it has the layman absorbed, and how much does he remember?

One means of finding a partial answer to this question was devised by the Division of Dental Health of the Minnesota Department of Health. A dental health test, consisting of twenty statements, has been given during the past year to a number of representative groups, in all several hundred persons. A glance at this test, reproduced on the next page, will show that it is objective, and the directions for checking the statements are self-explanatory. Each correct answer is worth five points in scoring. Names of persons marking the test are not asked for, only their occupations. This method prevents embarrassment for persons who are asked to mark the test but who feel that they know little about the subject.

Among the representative groups that took the test was a graduate class of physicians, a parent-teacher association group in a small Minnesota town, a teachers' institute representing an entire Minnesota county, a class of public health nurses, a group of nurses and teachers taking a course in school health problems and a class of university undergraduates in preventive medicine and public health.

SCORES BY ENTIRE GROUP

The findings based on the grades obtained on the test by these various groups are extremely interesting. Considering all the groups as a whole, and considering physicians as laymen in regard to dental health matters, we find that nine out of ten of all persons who took the test knew that artificial teeth are valuable in more ways than mere improvement of the appearance and that replacement of lost teeth costs from three to twenty times as much as filling the teeth. Eight out of ten knew that age 6 is too late for a child to make his first visit to the dentist; that toothache is not always due to neglect of toothbrushing; that decayed baby teeth should be filled, and that the only practical way of preventing loss of teeth from dental disease is early and frequent care by a dentist. More than seven out of ten knew that irregularity of the teeth may ad-

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DENTAL HEALTH STATEMENTS

If you think a statement has been proved to be true, check the Fact column. If you think a statement is definitely false, check the Fallacy column. If you think the truth or falsity of a statement has not been proved, check the Controversial column. At the end of the paper, write, in the space provided, your occupation (teacher, nurse etc.) Your signature is not required.

	Fact	Fallacy	Controversial
1. The teeth of pregnant women are more susceptible to decay than the teeth of childless women of similar ages.			
2. Pyorrhea is the chief cause of loss of teeth in persons over 40 years of age.			
3. The child should make his first visit to the dentist at the age of 6 years.			
4. Gumboils are dental abscesses and are dangerous to health.			
5. Noticeable irregularity of teeth may adversely affect a child's personality.			
6. Many permanent molar teeth have small defects in the enamel at the time they erupt.			
7. Teeth decay because of vitamin and mineral deficiencies in the daily diet.			
8. Chewing gum causes teeth to decay.			
9. Toothache always indicates that daily toothbrushing has been neglected.			
10. Dental research workers have not yet found the cause of caries.			
11. It is not important for a child's present or future health to have his decayed baby teeth filled.			
12. Bleeding of the gums always indicates the presence of pyorrhea.			
13. The only value of artificial teeth is in improvement of the personal appearance.			
14. Dental caries is always excessive in children who have rickets.			
15. Unless a pregnant woman adds extra calcium to her usual diet, her child will have poor teeth.			
16. Most dental abscesses are painless.			
17. Dental caries can be greatly reduced by eliminating refined sugar from the diet.			
18. The only practical way of preventing loss of teeth from dental disease is early and frequent care by a dentist.			
19. Loss of one lower first permanent molar does not affect the profile and facial appearance.			
20. Artificial replacement of a lost tooth is very likely to cost from three to twenty times as much as a filling, which would have prevented the loss of the tooth.			

Occupation_____

versely affect a child's personality, and that bleeding of the gums does not always indicate the presence of pyorrhea.

Going to the other end of the scale, we find that only 13 per cent of all laymen tested knew that the statement "Chewing gum causes teeth to decay" is controversial. Only 16 per cent knew that most dental abscesses are painless, and only 28 per cent realized that there is doubt concerning the alleged ultra-susceptibility to decay of the teeth during pregnancy.

SCORES BY GROUPS AS UNITS

Considering the groups now as separate units, we find, as we might expect, that the highest score for any group was made by the graduate physicians. Their median score was 65, and four of the twenty statements were marked correctly by every one in this group. Every physician tested knew that a child should make his first visit to the dentist before the age of 6; that bleeding of the gums does not always indicate the presence of pyorrhea; that artificial teeth do more for the patient than merely improve his appearance, and that replacement of teeth costs much more than filling them. On some statements, however, the scores of the physicians were astonishingly low. Only 28 per cent knew that pyorrhea is the chief cause of loss of teeth in persons over 40 years of age and that dental caries is not always associated with rickets in children.

Although the physicians as a group made the highest score, the best individual scores were made by nurses. The only persons, in fact, who have so far scored 90 or 100 on the test were two public health nurses.

The lowest median score (50) and the lowest individual score (20) were made by the university undergraduates who were taking a course in preventive medicine and public health. The parent-teacher association group made a slightly better median score (52.5) than the university students, and no member of the parent-teacher group made a score lower than 30. This result conforms with the findings obtained on the general health quiz given to visitors at the World's Fairs in 1933 and 1934—that adults generally possess more practical health information than young students, even though the students may have had a greater amount of formal education.

The parent-teacher group consisted mostly of mothers, but there were also three teachers and three fathers—a farmer, a blacksmith, and a banker. The farmer made the exceptional score of 70—exceptional because the median score for all groups that have taken this test is only 55, and each of the teachers in this group scored only 65. The parent-teacher association members made no 100-per-cent scores on any statement, but approximately eight out of ten of them knew these essential facts: that irregularity of teeth may adversely affect a child's personality; that many permanent molar teeth have small defects in the enamel when they erupt; that decayed baby teeth should be filled; that artificial teeth do more than improve the appearance; that early and frequent dental care is the only practical means of preventing loss of teeth, and that replacement of teeth costs a great deal more than filling them.

In the order of their median scores, the other three groups ranked as follows:

Class in school health problems (mostly nurses), 65

Public health nurses, 60

Teachers attending teachers' institute, 55

RESULTS OF THE TEST

From a survey of the results of the test, several facts stand out. First of all, we can be reasonably sure that dental health education of the public *is* effective when the education consists of facts

and not of theories. The best scores in all the groups were made on the statements that we are most sure of; the poorest scores, on statements that are still in the realm of theory. When we tell the layman things that we know to be true, and keep on telling him, he remembers those things. When, on the other hand, we burden him with unproved theories, he becomes confused and does not remember whether the theories that he has read or heard are facts, fallacies or guesses.

Another point brought out by the results of the test was the unexpectedly wide distribution of both dental health knowledge and dental health ignorance. The farmer in the parent-teacher group who scored 70 knew more about dental health than five out of seven physicians, and the physician who scored 40 knew less about it than the average teacher, nurse, parent or university undergraduate. This finding certainly means that dental health education needs to be broadened and adapted so that it will reach all groups with the sort of information that they need and can put into practice.

The test itself has been shown to be far from perfect and doubtless can be improved in many ways. In future tests, for instance, we believe it would be better to give our "pupils" only two columns to check instead of three; that is, to make each statement definitely "true" or "false," include no controversial statements and use only statements having a direct and practical bearing on dental health.

Of course, while high scores on a test indicate a high degree of information on the subject treated, such scores do not necessarily mean that the well-informed layman is putting his knowledge into practice. But it is certainly true that where correct information is lacking, the practice of dental health measures is also lacking. In most fields, there seems to be a fairly high correlation between health knowledge and health practices, and it is therefore legitimate to hope that, with the increase of dental health knowledge among laymen, there will be a corresponding increase in the number of persons obtaining early and frequent dental care, and hence in the number of teeth protected against advanced disease and eventual loss.

CORRECT ANSWERS TO DENTAL HEALTH TEST

1. Controversial.	11. Fallacy.
2. Fact.	12. Fallacy.
3. Fallacy.	13. Fallacy.
4. Fact.	14. Fallacy.
5. Fact.	15. Controversial.
6. Fact.	16. Fact.
7. Controversial.	17. Controversial.
8. Controversial.	18. Fact.
9. Fallacy.	19. Fallacy.
10. Fact.	20. Fact.

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July 1 *Editorial Department* 1943

HARVARD SCHOOL OF DENTAL MEDICINE

SOME three years ago, the Harvard Dental School abandoned the conventional plan of dental education that had been in effect for many years and undertook a revised curriculum of dental study and an entirely new dental educational scheme.

Now again we have from Harvard an announcement of another new plan, or a reversion to the former plan, of dental education.

In his address announcing the new plan for Harvard, President Conant noted the fact that constant change was a tradition at Harvard, and while we have not noted the instability implied in constant change to be a characteristic of Harvard, we are strongly in favor of all institutions of higher learning fostering such a tradition if it will bring about such happy results as in the change to the dental educational plan now being adopted by Harvard.

The degree of Doctor of Dental Medicine will be awarded at the end of four academic years, and the M.D. degree will be awarded on the completion of one and one-half academic years or one calendar year in the medical school. It is indeed pleasing to those close to the school

to know that the medical school has agreed to give credit toward the M.D. degree for work done in the third and fourth years in dentistry.

The latest plan provides that the dental student shall have the same course of instruction during the first two years as the medical student; i.e., through the basic medical science courses. An unfortunate feature of the present program is that the number of students in each dental class must necessarily be restricted. The medical school formerly admitted 125 students, and as the facilities for the first two years will not accommodate more than 125, it will be necessary to limit the medical students to 110 and the dental to fifteen. It is sincerely hoped that the facilities may be rapidly increased to the point where the number of dental graduates will return to normal.

At the time when the change to the now abandoned plan was made, we criticized the new program as a misguided experiment and one that could bring no good to the dental educational system or to the profession, and we are much pleased that the Harvard authorities have so quickly realized the futility of the experiment. We hail with the same degree of acclaim and approval the present reversion as that with which we disapproved the former diversion from the straight and narrow path of dental education. We confidently hope that when the present plan arrives at the point of working smoothness, other and equally agreeable changes will rapidly take place.

The one encouraging feature imposed by the present plan for the moment is that, with such a small class of fifteen, practically all the instruction in the third and fourth years of the dental course will be on the seminar basis, which, after all, is the most effective method of teaching.

It may be noted here again that Harvard was the first dental school to be associated with a university and thus had established a background for a humanitarian and cultural profession that was beginning to stand us in good stead. But when Harvard reversed its position—retraced its steps, as it were—we witnessed the anomaly of the school that first established a university association abandoning its course and adopting another that could only retard the development of dental education as a university entity.

Now that she has regained an even keel, Harvard is in position to again become a leader in the dental educational field and an influence no less important than she has been throughout her history.

In admitting quite frankly the failure of the experiment, President Conant outlined the new program and plan which would be put into

effect immediately and in which the fundamental principles of the 1939 program have been embodied so far as is consistent with present-day conditions.

In contemplative anticipation of still further changes if the present course appears to demand it, President Conant has irrevocably committed Harvard and himself to two fundamental principles in dental education at Harvard:

> There are just two things in connection with the future of dental education at Harvard on which I venture to be dogmatic: (1) we have no intention whatsoever of abandoning the fundamental principles in this reorientation of our dental work, and (2) we have no idea whatsoever of abandoning instruction in dentistry or giving up our interest in trying to carry on our seventy-five year old tradition of leadership in that branch of the medical profession. On these points I can speak with confidence not only personally, but also on behalf of the Governing Boards.

We are indeed pleased to have this assurance of the unwavering purpose of Harvard toward a renewal of its effort to educate dentists as such rather than to attempt to submerge the school and the profession into medicine.

One of the disrupting features of Harvard's dental educational effort in the recent past has been her hesitancy in following the present-day ideal of educating the dentist to practice dentistry as a branch of the healing art rather than as a specialty of medicine. And we take it that the failure of this latest experiment in dental education is further proof of the desirability of a dental curriculum based on a purely dental conception rather than the medical one. If Harvard's recent experiment does nothing more, it will have confirmed our belief that dentistry should be an autonomous profession, with a curriculum directed to making dentists.

NATIONAL WARTIME NUTRITION PROGRAM

In another department of this issue, we present the National Wartime Nutrition Program being projected by the Food Distribution Administration of the United States Department of Agriculture in an effort to help solve the nutrition problems resulting from the demands of the Army and Navy upon our normal food supply.

At a time when radio announcers are flooding the country with confusing statements about vitamins, food values and diet, it is well

that serious attention be devoted to the choice of a diet that will agreeably meet the actual living requirements of the individual.

We have long believed that a diet properly balanced in the three characters of food essential to adequate nutrition is the secret of nutritional balance. And this the Food Administration is endeavoring to guide.

To that end, the Food Administration has designed a graphic chart representation of the seven basic food groups needed in the every day diet. The chart is reproduced in the Department of the Bureau of Public Relations, presenting by groups, and in a manner much more readily acceptable than the radio vitamin food and drug high pressure salesmanship, the foods that should be the foundation of the daily diet.

Now, with a decreased supply of food and the coming of point rationing, it is more necessary than ever to know, to practice and to teach the principles of nutrition. It has become doubly important for every one to know how to utilize available food for health, and how to choose alternate foods that make three good meals a day, even if some foods are limited.

This long-established custom of three meals a day is not "just a habit." Science proves that we need the varied nutrients from many foods, and that we also need to enjoy eating. The National Wartime Nutrition Program will help us to meet these two food requirements.

DEATH OF DR. FREDERICK W. HINDS

WE have just learned of the sudden death of Dr. Hinds, dean of the Baylor University Dental School, Dallas, Texas, which occurred on Friday, June 4, 1943.

An obituary notice will appear in a later issue of THE JOURNAL.

DEATH OF DR. ELLISON HILLYER

IT is with much sadness that we announce the death of Dr. Hillyer, which occurred at his home in Brooklyn, N. Y., May 3, 1943.

An obituary notice will appear in a later issue of THE JOURNAL.

BIBLIOGRAPHICAL

Clinical Anesthesia. A Manual of Clinical Anesthesiology

By JOHN S. LUNDY, B.A., M.D., Head of the Section on Anesthesia, Mayo Clinic; Professor of Anesthesia, Mayo Foundation for Medical Education and Research, Graduate School, University of Minnesota; Diplomat and member of the American Board of Anesthesiology, Inc.; Member of the Sub-Committee on Anesthesia National Research Council. 771 pages; 266 illustrations; 50 tables. Price $9. Philadelphia: W. B. Saunders Company, 1942.

AFTER eighteen years of careful observation and accumulation of records, John S. Lundy of Mayo Clinic has prepared this manual describing methods of producing local anesthesia in all parts of the body, as well as general anesthesia. Emphasis is placed upon descriptions of technics. In this book are no lengthy philosophical discussions of theories related to anesthesiology. The author starts on page two to give the choice of anesthetic agents and methods for operations on the head. The various operations are listed in alphabetical order and terse descriptions of the anesthesia of choice are given. Many of the data are presented in table form.

Dental local anesthesia is discussed in a chapter of twenty-two pages written by L. T. Austin, D.D.S., and E. C. Stafne, D.D.S., of the Dental Division of the Mayo Clinic The authors describe in adequate detail the accepted technics for producing local anesthesia for oral operations. As in other sections of the book, methods and materials used are emphasized. Little attention is given to discussions of indications and contra-indications for local anesthesia in dentistry. The authors reported that they have used the barbiturates for premedication for seven years, with varying results. Administration of such drugs has been largely limited to hospitalized patients. When they are used, 3 grains of pentobarbital sodium given orally one hour before the operation in the hospital (one-half that dose for apprehensive patients not in the hospital) seems helpful.

Other sections of the book include technics for local anesthesia of the orbit, urethra and bladder, bronchoscopy and spinal anesthesia. Almost one-half of the book is devoted to "general anesthesia," its stages and signs, care of the patient before and after its use, etc. The chemical basis of the efficacy and toxicity of anesthetics is outlined.

The illustrations, mainly line drawings, are helpful. Short bibliographies to current literature are given in each chapter. An interesting chronology of historical events relating to the development of anesthesiology from 4000 B.C. to 1941 is given in chapter twenty-nine.

The book is well organized and indexed and seems carefully prepared. It should prove useful to students, interns and dentists who are called upon to use local and general anesthesia. M. K. HINE.

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COMMITTEE ON LEGISLATION

SPECIAL NOTICE ON MAIL ORDER DENTURE LAW

THERE has arisen considerable confusion regarding the enforcement of the so-called Mail Order Denture Law, also known as the Traynor Law.

The Post Office Department has issued an order requiring that every package containing a denture or partial denture shall carry a label on the address side reading as follows: "Mailing not prohibited by Sec. 607½, P. L. & R., 1940." When the Post Office Department first issued the order to stop interstate shipment by mail of dentures not made in conformity with the Traynor Law, the intent of this order was not fully understood by many postmasters and much confusion arose.

Under date of June 11, the Post Office Department issued in the Postal Bulletin a special explanatory communication to the postmasters of the United States entitled "Instructions of the Solicitor," which explained that the above label applied only to packages containing dentures (false teeth) or partial dentures, and that packages containing impression materials, impression trays, wax bites or casts should be dispatched and delivered regardless of whether or not they bear the endorsement described above. The instructions of the Solicitor further provide that, pending expiration of a reasonable period for the securing of printed labels or rubber stamps, this endorsement may be in typewriting or printed in ink by hand.

The Mail Order Denture Bill, as passed by Congress, was copied word for word into the Postal Laws and Regulations and is now known as Section 607½, P. L. and R., 1940. In order to avoid further confusion and misunderstanding on the part of postmasters and other postal employes, although this law does not require labels on all types of packages, the Committee on Legislation recommends that each dentist place this label on all packages going to the laboratories or to any of his patients.

The adoption of this label as a postal regulation is one of the important preliminary steps in the enforcement of the Traynor Law, which has been enacted through great effort, and the enforcement of which will require the fullest cooperation on the part of the dental profession.

When the Traynor Law was enacted, it was mutually agreed among all concerned that a period of six months' grace would be given before legal prosecution of violators of the law. This period expired June 24, 1943.

If any dentist experiences any difficulty or has any suggestions or has any knowledge of any infraction or violation of the law, he should notify the chairman of the Committee on Legislation, Sterling V. Mead, Washington, D. C.

Further information will be furnished to the dental profession from time to time.

STERLING V. MEAD, *Chairman,*
Committee on Legislation.

WAR SERVICE COMMITTEE

PROCUREMENT AND ASSIGNMENT SERVICE

Maj. Gen. Lewis B. Hershey, National Director of Selective Service, has informed all state directors of the existing great need for medical doctors and dentists to fill the medical personnel requirements for Army units and has called on all state directors to reconsider the status of all physicians and dentists who are at present deferred by their local boards from military service by reason of occupation and who, except for such deferment, would be liable to military service under the Selective Training and Service Act of 1940, as amended.

Therefore, it is desired, through the proper societies and journals, to inform the medical and dental professions of the policies under which the occupational deferment adviser for medical doctors and dentists will operate. These policies are outlined as follows:

(1) Medical doctors and dentists who have been declared available for military service by the Procurement and Assignment Service will be selected and delivered for induction by Selective Service local boards without avoidable delay. In such selection for induction, draft boards are not authorized to give consideration to any application for commission in the Medical Corps of the Armed Forces which may be pending.

(2) Medical doctors and dentists who are serving residencies in hospitals and other institutions cannot qualify for occupational deferment from military service. Occupational deferment in such cases will not exceed twelve months. Consideration for occupational deferment will not be accorded to doctors in residence who are engaged primarily in the furthering of their medical education.

(3) Doctors on medical school faculties and doctors engaged in industrial medicine who are acceptable to the armed forces cannot be continued in occupational deferment and will be selected for induction by draft boards on recommendation from the state director. A reasonable time period will, where necessity is clearly shown, be accorded a medical school or an industry to replace its young doctors and dentists.

(4) Medical doctors and dentists who make application for commission in the armed forces and who are not acceptable to the armed forces by reason of physical defect or lack of citizenship will not be selected for induction by local boards.

General Hershey, commenting on medical doctors and dentists who have volunteered their services and who have been rejected through no fault of their own, directed that duly licensed physicians and dentists who cannot be used by the armed forces in their professional capacity, when their services can be used by the civilian population, should be given occupational classification by Selective Service local boards.

It is recommended that all medical doctors and dentists liable to selection for induction determine their acceptability to the armed forces by applying for a commission. It is pointed out that a doctor rejected by the Navy may be acceptable to the Army and that local boards cannot give occupational classification to a doctor until he has been rejected by the Army.

It is emphasized that this release pertains only to doctors and dentists who have not reached the thirty-eighth anniversary of their birth and who do not have children born prior to September 15, 1942, with whom they are maintaintaining a bona fide family relationship in their homes.

BUREAU OF PUBLIC RELATIONS

THE BASIC SEVEN FOOD GROUPS

IN the new official wartime nutrition food chart of the National Wartime Nutrition Program, the seven food groups and the slogan "Eat the Basic 7 Every Day" have been adapted to the current food situation. Copies of this chart in six colors will be available about the middle of June.

A folder, "The National Wartime Nutrition Food Guide," which will explain the "basic 7" will probably be ready for distribution the latter part of July. This folder gives practical suggestions for meeting wartime food shortages without sacrificing nutrition.

Both the chart and the folder may be obtained without cost from the regional offices of the Food Distribution Administration. The charts will be of interest to both dentists and their patients, who will find the folder helpful in solving wartime food problems.

The slogan "U. S. Needs Us Strong—Eat the Basic 7 Every Day" retains the best part of the former slogan, "U. S. Needs Us Strong—Every Day Eat This Way," and stresses the "basic 7" food groups. The circular presentation of the seven food groups emphasizes the fact that all groups are important and avoids putting any one group ahead of the others.

The Nutrition Division of the Office of Defense Health and Welfare Services, Federal Security Agency, is now incorporated in the Department of Agricul-

REGIONAL OFFICES OF FOOD DISTRIBUTION ADMINISTRATION

Region	Address	States Included
Northeast	150 Broadway, New York, N. Y.	Connecticut, Delaware, District of Columbia, Maine, Maryland, Massachusetts, New Jersey, New Hampshire, New York, Pennsylvania, Rhode Island, Vermont, West Virginia
Southern	Western Union Building, Marietta & Forsyth Sts., Atlanta, Ga.	Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, Tennessee, Virginia
Southwest	425 Wilson Bldg., Dallas, Texas	Arkansas, Oklahoma, Texas, Louisiana
Rocky Mountain	Burns Vault Bldg., 1536 Welton St., Denver, Colo.	Colorado, Idaho, Montana, New Mexico, Utah, Wyoming
Pacific	821 Market St., San Francisco, Calif.	Arizona, California, Nevada, Oregon, Washington
Midwest	Old Colony Bldg., Grand Avenue at West Tenth St., Des Moines, Iowa	Iowa, Kansas, Minnesota, Missouri, Nebraska, North Dakota, South Dakota
Great Lakes	5 Wabash Ave., Chicago, Ill.	Illinois, Indiana, Ohio, Michigan, Wisconsin

ture Food Distribution Administration, as the Nutrition and Food Conservation Branch.

The state and local nutrition committees previously affiliated with the Nutrition Division will continue their work with the Nutrition and Food Conservation Branch. They will, as in the past, act as the integrating and coordinating agencies for the activities of all groups engaged in improving nutrition. The regional nutritionists, with headquarters at the Food Distribution Administration regional offices, will continue to work with state and local nutrition committees.

For Health...eat some food from each group...every day!
GROUP ONE
GREEN AND YELLOW VEGETABLES...
some raw—some cooked, frozen or canned
GROUP TWO
ORANGES, TOMATOES, GRAPEFRUIT...
or raw cabbage or salad greens
GROUP THREE
POTATOES AND OTHER VEGETABLES AND FRUITS
raw, dried, cooked, frozen or canned
GROUP FOUR
MILK AND MILK PRODUCTS...
fluid, evaporated, dried milk, or cheese
GROUP FIVE
MEAT, POULTRY, FISH, OR EGGS...
or dried beans, peas, nuts, or peanut butter
GROUP SIX
BREAD, FLOUR, AND CEREALS...
Natural whole grain— or enriched or restored
GROUP SEVEN
BUTTER AND FORTIFIED MARGARINE
(with added Vitamin A)
U.S. NEEDS US STRONG
EAT THE BASIC 7 EVERY DAY
U.S. GOVERNMENT CHART
IN ADDITION TO THE BASIC 7...
EAT ANY OTHER FOODS YOU WANT

The basic seven food groups.

The program of the Nutrition and Food Conservation Branch includes the following:

1. A nationwide educational program

on all phases of good nutrition geared to the wartime food situation and including:

a. Efficient utilization of available foods, shown by food demonstrations.

b. Conservation of the physical volume and nutritive value of food, from production point to table.

c. Food preservation programs covering methods of home and community canning.

2. Support of community nutrition programs such as school lunch programs.

3. Guidance and assistance with in-plant feeding projects for industrial workers.

4. Assistance to state and local health departments in planning and carrying out public health nutrition programs which are closely tied in with the activities of the local nutrition committees; offered in cooperation with the United States Public Health Service.

Regional offices of the Food Distribution Administration are located as shown in the accompanying table.

DENTIFRICES AND MOUTHWASHES*

THE subject of dentifrices and mouthwashes is an important one, not because of the intrinsic worth of these preparations as therapeutic agents, but because they are widely used and because advertising propaganda for them is constantly before the public. Claims and counterclaims for numerous brands of dentifrices and mouthwashes cannot fail to have some bearing on the public's concept of dentistry. The influence that such advertising may have is determined by a number of facts, including the nature of claims made and, above all, the public understanding and appreciation of the true functions and properties of these agents.

Dentifrices are preparations used in conjunction with the toothbrush for the purpose of cleaning the teeth. These products act as an aid to the brush. On the basis of our present knowledge, they are classified as cosmetic agents, and as such serve a useful purpose.

That tooth powders are not modern inventions can readily be seen from the fact that they were in use among the Chinese more than 4,000 years ago. At that time, a favorite dentifrice ingredient was the powdered bones of small animals. Thus, the substances calcium carbonate and calcium phosphate, in a crude form, to be sure, were long ago used as dentifrice ingredients. The ancient Greeks and Romans were also familiar with dentifrices of various sorts. During the Middle Ages, the Arabians attached great importance to the cleanliness of the teeth and advised against the use of very hard powders because of their damaging effect on tooth substance.

During the past half century or more, there has been increasing emphasis on the use, sale and distribution of dentifrices, the estimated number of dentifrices on the American market at the present time being about 800. It is to be noted, however, that, even at the present time, the majority of our people still do not use dentifrices regularly.

*The growth of public interest in dental health has resulted in a marked increase in requests for information on different phases of the subject. To meet this demand, the Public Health and Education Committee, now a committee of the Council on Dental Health, has authorized the preparation of a series of articles in pamphlet form, each article to deal with one of the dental questions most frequently asked by the public.

The current article, "Dentifrices and Mouthwashes," by Harold L. Hansen, Ph.D., can be obtainted in reprint form at a nominal cost by addressing the Bureau of Public Relations, American Dental Association, 222 E. Superior St., Chicago, Ill.

The past diversity of opinion on the function and proper composition of dentifrices has led to the development of a wide variety of products of this class. In fact, there is so much variation in the composition of products that classification of dentifrices is not an easy matter. From one standpoint, dentifrices may be readily classified into the three large groups of pastes, powders and liquids. From the practical standpoint, most toothpastes and toothpowders can be said to be composed of these substances: detergent (soap or a soap substitute), polishing agents (calcium carbonate or chalk, dicalcium phosphate, tricalcium phosphate) and flavoring agents.

In toothpastes are also found such substances as glycerin and various gums, which serve to give products of this class their characteristic physical form. Liquid dentifrices differ, for the most part, from the conventional toothpastes and toothpowders in that they contain no polishing agent.

Since dentifrices are properly considered cosmetic agents, and since these products are widely and indiscriminately used, considerable emphasis should be placed on the composition of these preparations from the standpoint of safety. In this connection, the abrasive properties of dentifrices, or, as they are sometimes called, the polishing properties, have been given careful consideration. For several years, the American Dental Association's Council on Dental Therapeutics has required that the polishing agents in dentifrices be made acceptable on the basis of physical properties and abrasive tests before such ingredients may be included in the list of accepted products. This ruling was made to exclude harsh abrasives from dentifrice preparations. In addition to this, the Council has required that acceptable data on the abrasive properties of the finished dentifrice also be provided. There are several methods available for testing the abrasiveness of dentifrices and insoluble constituents of dentifrices. Two of these methods are in common use. One consists of the mechanical rubbing of a metal test piece in contact with the product being examined. From the loss in weight of the metal test piece, some conception of the effect of the product under long-continued use can be obtained. Thus, if the dentifrice or the insoluble constituent used in its preparation produces excessive wear on the metal test piece, the preparation should be rejected.

In addition to wear on the dental enamel, a polishing agent might be harmful because of the presence of a few hard, sharp particles. The presence of particles of this kind can be detected by a simple but ingenious test. The toothpaste or a toothpowder made into a paste with water is rubbed on a glass microscope slide by means of a 5-cent piece. If the product contains hard sharp particles, scratch lines will appear on the glass. Since the dental enamel is harder than the glass ordinarily used in the making of glass microscope slides, a simple means is at hand for ruling out potentially "scratchy" materials.

In some instances, recession of the gums may occur to such an extent as to expose dentin and cementum, which are both softer than enamel, to the action of the brush and the dentifrice. This presents the possibility of causing harm to these structures. The possibility of harm will, however, be greatly reduced by proper methods of brushing and by selection of an accepted dentifrice. In some of these cases, it may be advisable to forego the use of a dentifrice, relying on the use of a brush, which is after all the essential tool in cleaning the teeth. In other instances, if a flavored preparation is desired, liquid dentifrices can be used with allegedly beneficial results. It should be noted, however, that these liquid dentifrices are in many cases inferior to toothpastes and toothpowders as cleansing agents. A substantial number

of persons who have used these liquid preparations have reported staining of the teeth, which may be due to the absence of a polishing agent in the preparations.

Dentifrices should not contain strong antiseptics, germicides and other products potentially irritating to mouth tissues. Apart from the possible harmful effects from the presence of these ingredients, there is no definite evidence of their usefulness. Their alleged usefulness may also give the user a false sense of security, with the result that he delays seeking competent dental advice and care.

Dentifrices consisting essentially of sodium perborate are known to cause mechanical burns of the oral tissues in some persons. Preparations of this class should therefore be used, if at all, under the supervision of the dentist.

The proper and intelligent use of dentifrices is so largely dependent on a knowledge of the nature and function of these preparations that users would do well to keep in mind the following statement by the Council on Dental Therapeutics:

> Dentifrices are generally mixtures used on the teeth in conjunction with a toothbrush without demonstrated medicinal, curative or prophylactic virtues. Dentifrices for daily use should not contain harmful or objectionable ingredients. They are used to assist the toothbrush in cleaning the surfaces of the teeth.

This statement should not be taken to mean that dentifrices are worthless articles, but it obviously does not lend a basis for a number of unwarranted advertising claims, such as the currently used "pink toothbrush," "acid mouth" and "bad breath" scares. While these therapeutic claims have been made frequently over a long period of time, they do not rest on a sound basis of established facts. Therefore, selection of a dentifrice should be based upon efficacy as a cleansing agent, demonstrated harmlessness to both hard and soft tissues of the mouth and truthfulness of advertising claims. The use of a toothpaste or a toothpowder is largely a matter of personal choice. No essential difference in cleansing properties has been established.

The Council on Dental Therapeutics awards the Seal of Acceptance to dentifrices in accordance with its published rules. Each dentifrice on the accepted list is reconsidered annually, at which time it may be retained on the list or be omitted, its inclusion depending on meeting the Council's requirements. The general requirements for acceptance may be summarized as follows:

1. Satisfactory evidence of safety under conditions of use.
2. Presentation of complete formula.
3. Acceptable advertising.

Dentifrices meeting these requirements and certain other conditions set up by the Council are eligible to bear the Seal of Acceptance.

A free list of accepted dentifrices may be obtained on request to the Secretary of the Council on Dental Therapeutics, American Dental Association, 222 East Superior St., Chicago, Ill.

MOUTHWASHES

In the advertising of mouthwashes, much is made of the ability of these products to kill germs. Several years ago, the Council on Dental Therapeutics evaluated the information available on the ability of these mouthwashes to disinfect the mouth under the usual conditions. The Council pointed out that no method, or combination of methods, has been devised that will afford a thoroughly satisfactory comparison of germi-

cidal agents in test tubes and under the conditions in which they are actually used. Even when tremendous numbers of bacteria are removed from the mouth, there is no way of even roughly estimating the number remaining or the rapidity of replacement. Data purporting to show the decrease in the number of bacteria in the mouth after the use of a particular agent are based on attempts to determine the influence on the bactericidal count in ejected saliva on consecutive rinsings with or without mouthwashes. The results obtained by such methods are not entirely convincing because no information whatever is afforded as to the kind or number of viable bacteria remaining in the mouth.

The Council categorically stated that the general use of mouthwashes can be considered to serve no more intrinsic purpose than as an aid in the mouth toilet in the removal of loose food and débris, and that the main action appears to be due to mechanical rinsing. It can be stated with equal emphasis and on the same grounds that the mouth of the normal person has not been shown to be in need of medicated "mouthwashes."

Since mouthwashes are commonly promoted as cures for bad breath, it is well to bear in mind that this poorly defined term has been subjected to misuse. The causes of bad breath are many and varied. Indeed, it is reasonable to believe that practically every one is subject to this condition at times. Unpleasant odors of the breath may be due to local conditions or to systematic disease. Among the local causes may be mentioned diseases involving the mouth and throat, faulty dental restorations, abscesses of the teeth and the presence of food débris. Among the common systemic diseases causing bad breath are constipation, diabetes and diphtheria. Obviously, a mouthwash, no matter how pleasantly flavored, cannot be expected to be of value in all of these conditions. Therefore, reliance should be placed on diagnosis of the trouble, followed by effective remedial measures.

An "antiseptic" mouthwash is one that meets certain test requirements of the Food and Drug Administration. This laboratory test was not designed to show the effectiveness of mouthwashes under practical conditions, but rather was adopted as an aid in the administration of the law. Numerous mouthwashes, some of them promoted with therapeutic claims, have been found to be not antiseptic when tested according to the method adopted by the Federal Government. Even those which pass the test and may legally be designated "antiseptic" are of questionable value for prolonged or indiscriminate use.

A statement in the "Home Medicine Cabinet," put out by the Consumers' Project of the United States Department of Labor, summarizes the situation aptly:

> Mouthwashes may be somewhat useful in that the vigorous use of them after brushing the teeth rinses from the mouth any food particles loosened by the brushing. They cannot do more. No mouthwash can remove film from the teeth, neutralize the mouth acidity nor cure halitosis. The consumer who wishes to use a mouthwash should know its composition, for the use of a mouthwash containing phenol or sodium perborate over a long period may harm the mucous membrane of the mouth. A solution of salt water of normal strength, two (2) teaspoonsful of salt in a quart of water, is the safest and least expensive mouthwash available.

NATIONAL CONFERENCE FOR COOPERATION IN SCHOOL HEALTH EDUCATION

PRINCIPLES ON SCHOOL DENTAL HEALTH

THE National Conference for Cooperation in School Health Education, organized in 1938, consists of representatives of approximately forty-six national official and voluntary health and educational agencies, all of whom are interested in some phase of school health education. The objective of the conference is to promote the development of adequate school health education, and public interest in school health programs, and to make more accessible to the schools existing health education materials and services.

One of the first undertakings of the conference was to request the establishment of a set of principles on school dental health service.

The responsibility of setting up these principles was assigned to the School Dental Health Committee consisting of Frank C. Cady, chairman, Randolph G. Bishop, secretary, Vern D. Irwin, William J. Hamilton, superintendent of Oak Park, Ill., schools, and Lon W. Morrey.

The following set of principles accepted by the National Conference at its April 28, 1943 meeting, while basically sound, are not to be construed as final as they may be revised from time to time in the light of accumulated experience.

A STATEMENT OF PRINCIPLES ON DENTAL HEALTH OF THE SCHOOL CHILD

I. Dental Health Education

A. Subject matter to be taught in the field of dental health.

a. Educators should understand that dental health is an integral part of general health and is essential to normal growth and development of the child.

b. Children should be taught the need for early and periodic examination and treatment and the importance of daily mouth cleanliness and proper diet.

B. Gradation of dental health education material.

a. The gradation of this material should be in line with the development and needs of the pupils at all stages of normal growth.

b. Factual material for use of the schools in the preparation of teaching material has been prepared by the American Dental Association and most state health departments.

This material can be obtained by addressing:

The National Dental Hygiene Association, Shoreham Building, Washington, D. C. (for the A.A.P.H.D.)

The Bureau of Public Relations, American Dental Association, 222 East Superior St., Chicago, Ill.

Your State Health Department, Dental Division.

C. Time allotment for dental health education.

a. Since dental disease is the most prevalent of the physical defects among school children, dental health education should occupy a significant and integral place in the program of health education of the school. The amount of time allotted to this subject can be governed, to a degree, by the dental health status of the pupils as determined by evaluation methods. (See par. I-E.)

D. Integration of dental health education in various subjects.

a. Dental health education should be made an integral part of all instruction in science and health education throughout the elementary and secondary schools.

E. Procedures to be used in evaluating dental health education and education materials.

a. The effectiveness of dental health education can be evaluated in terms of the percentage of children in the school system who have all dental defects cor-

rected before the end of the school year as shown by correction certificates returned by the dentists. Another method is a check on the number of lost permanent teeth per hundred children at the respective age levels. These evaluation studies should be a cooperative project of the school and the dental division of the health department.

b. Instruction materials should be evaluated upon a basis of scientific knowledge and accepted educational procedures and methods. Only materials the factual content of which has been approved or provided by the organizations listed in paragraph I-B should be used.

II. Dental Health Services

A. Criteria for adequate dental treatment for school children.

a. Elimination of all mouth infections.

b. Filling of all fillable teeth (primary and permanent).

c. Filling of all defective pits and fissures in permanent teeth.

d. Prophylaxis, orthodonics and replacement of missing teeth where indicated and possible.

B. The relationship between the community and the school dental health program.

a. Dental health programs should be a cooperative effort on the part of the schools and the official and non-official health agencies of the community to define the problem, determine available resources and develop and execute plans.

C. Relationship between school dental health program and the dental profession.

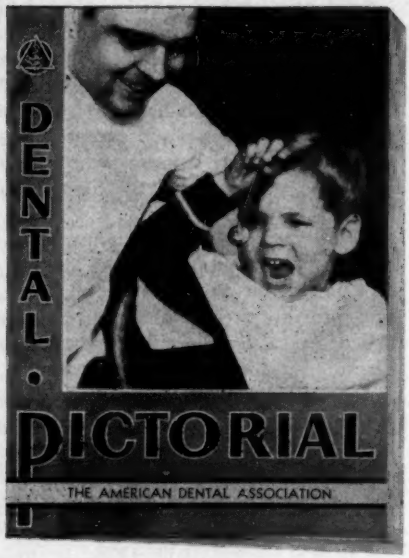
a. The schools should educate the child as to the importance of dentistry as a health service. The dental profession provides treatment and should be called upon for consultation and cooperation in the educational program.

D. Relationship of the schools and the health department in the promotion of the school dental health program.

a. The schools should utilize the facilities of their state and local health departments in all phases of the program other than classroom teaching.

E. Educational value of dental treatment of the school child.

a. Since the educational values in any experience are in direct proportion to the background in which it is presented, teachers should utilize dental services for children in both private and public agencies, to motivate and promote correct attitudes toward dental health.



Now Is the Opportune Time to Use

DENTAL PICTORIAL

BECAUSE the nation has set a new high value on the necessity of maintaining efficiency through good health

BECAUSE the nation realizes that constructive educational material can help people help themselves

BECAUSE our families need nutrition guidance and information on hygiene and dental care

BECAUSE industry regards as paramount the need of maintaining the health of every worker everyday

BECAUSE health officials need more authentic material to implement their health programs

BECAUSE educators need reliable teaching aid to help prevent illness at a time when the country lacks adequate medical, dental and nursing facilities

DENTAL PICTORIAL can make a great contribution to the public good. It can aid in the war effort through its program of dental education for the parent, school child, teacher, health worker, patient and dentist.

MAILED DIRECT FOR YOU TO PATIENTS, TEACHERS AND HEALTH WORKERS

TURN TO PAGE A-11 FOR FURTHER INFORMATION ON *DENTAL PICTORIAL*

COUNCIL ON DENTAL THERAPEUTICS

FEDERAL TRADE COMMISSION COMPLAINT ON TEEL

THE Federal Trade Commission has issued a complaint charging Procter and Gamble Co., Cincinnati, with misrepresentation of its liquid dentifrice designated "Teel" and with consequent unfair disparagement of tooth pastes and powders sold by competitors. Of the several ingredients of Teel, its principal cleansing agent is sodium alkyl sulfate, which possesses detergent qualities similar to those of soap.

Advertisements disseminated by the respondent in newspapers, periodicals and circulars and over the radio, the complaint alleges, represent, among other things, that Teel is a revolutionary discovery in dental science; that it cleans teeth to the highest degree and is a complete and satisfactory substitute for the popular brands of tooth pastes and powders; that most of such pastes and powders contain abrasives and cut cavities which require filling in the soft portions of the tooth structure exposed by receding gums; that a large proportion of the public are constantly exposing their teeth to serious damage through the use of tooth pastes and powders, and that the insolubility, in water, of the ingredients in tooth pastes and powders is evidence of the presence of harmful abrasives.

These representations, the complaint charges, not only are false and deceptive, but also unfairly defame and disparage competing products in that they represent that the most widely used tooth pastes and powders are harmful to the teeth and dangerous to use when such is not a fact.

While most tooth pastes and powders contain abrasives, they do not, the complaint alleges, cut cavities which require filling, nor does abrasion arising through the use of the popular brands of tooth pastes and powders commonly cause such cavities, and no large percentage of the people expose their teeth to serious damage by cleansing with such dentifrices. Since Teel has no abrasive qualities, the complaint continues, it cannot so effectively clean teeth; it is inferior as a cleansing and polishing agent to many of the popular brands of pastes and powders and its use permits discoloration, which can be removed from the teeth only by a substance having abrasive properties. A mild abrasive such as is contained in most tooth pastes and powders is desirable and necessary in an effective dentifrice, the complaint alleges.

Twenty days is allowed for answering the complaint, which alleges that the respondent's misrepresentations and disparagement of competing products constitute unfair methods of competition and unfair and deceptive acts and practices in violation of the Federal Trade Commission Act.

Complaint 4937 Monday, April 5, 1943

FEDERAL TRADE COMMISSION COMPLAINT ON IPANA TOOTHPASTE

BRISTOL-MYERS Co., Rockefeller Center, New York, distributor of Ipana toothpaste, and Pedlar & Ryan, Inc. and Young & Rubicam, Inc., both advertising agencies for the Bristol-Myers Co., are charged in a complaint issued by the Federal Trade Commission with misrepresentation. Pedlar & Ryan, Inc., 250

Park Ave., and Young & Rubicam, Inc., 285 Madison Ave., New York, are advertising agents and have participated in the preparation and dissemination of the advertising matter to which reference is made in the complaint.

The complaint alleges that the respondents have misrepresented the properties of Ipana toothpaste in a number of respects, including, among others, its value in producing a beautiful smile, increasing the popularity of the user, removing yellowish tint and in whitening teeth not naturally white; its therapeutic value in the prevention, treatment and cure of so-called "pink toothbrush" and neglected gums; its benefit in imparting strength, firmness and health to soft, tender gums, which are alleged to be represented by the respondents as being susceptible to "gum trouble" and as being produced by the current American diet of "soft," "creamy," "well cooked" foods, a diet which, the respondents are alleged to represent, does not give the gums sufficient work, exercise and stimulation. It is alleged that the respondents have misrepresented the number of dentists who use and recommend Ipana because of the belief of such dentists in the efficacy of the product and its superiority over competing products.

The complaint states that a beautiful smile or increased popularity is dependent on many factors which would not be influenced by using the product; that many persons have teeth with a natural yellow tint, or a yellow tint produced by tobacco or other stains, and which would not be whitened through the use of the product; that the product has no substantial therapeutic properties of value in the prevention, treatment or cure of the conditions existing in the case of so-called "pink toothbrush" gums, which cause the gums to bleed sufficiently to color the toothbrush pink; that there has been no change in the diet of the American people which has been of any consequence so far as the gums are concerned, as the healthy condition of the gums is not dependent on the amount of "exercise" that they receive in chewing food, but upon the general condition of the system and the supporting mechanism of teeth, and that the number of dentists using and recommending the product to their patients is not indicative of the number who actually chose it because of a belief in its efficacy or its superiority over competing products, for the reason that the product has for many years been distributed lavishly and gratuitously among dentists and its use in the profession is attributable to this practice.

Twenty days is allowed the respondents for filing an answer.

Complaint 4861. October 31, 1942.

ACCEPTED DENTAL REMEDIES

The Council on Dental Therapeutics of the American Dental Association announces the inclusion of the following articles in the list of Accepted Dental Remedies.

DENTIFRICES*

Gertz Tooth Paste: Composition: See Sheffield Tooth Paste (A.D.R. Ed. 8, p. 113).

Manufactured by The Sheffield Co., New London, Conn. Distributed by B. Gertz, Inc., Jamaica, Long Island, N. Y.

CALCIUM COMPOUNDS†

Calcium Carbonate, U.S.P. Precipitated-Merck: Calcium Carbonate U.S.P. Precipitated-Merck is stated to comply with the U.S.P. It is used in the manufacture of dentifrices.

Distributed by Merck & Co., Inc., Rahway, N. J.

CHEMICAL ANALYSIS: 98.5 per cent calcium carbonate.
PHYSICAL PROPERTIES:
PARTICLE SIZE:

Diameter in Microns	
Less than 5	5 to 7
90%	50%

ABRASIVENESS: The average loss in weight of antimony strips (microbrinell hardness 43±5) when brushed for 10,000 double strokes under a weight of 228 gm. with a slurry of calcium carbonate-Merck in 50 per cent v/v glycerin-water mixture to which gum tragacanth was added was 4.9 mg. Abrasiveness data were obtained in the A.D.A. Bureau of Chemistry, using a reciprocating brush-type machine. Other data listed above for Calcium Carbonate U.S.P. Precipitated-Merck were supplied by the firm.

Calcium Phosphate Tribasic U.S.P.-Precipitated-Merck: A brand of tricalcium phosphate, U.S.P.

Distributed by Merck & Co., Inc., Rahway, New Jersey.

PHYSICAL PROPERTIES:
PARTICLE SIZE:

Diameter in Microns	
1 to 10	10 to 60
85%	15%

ABRASIVENESS: The average loss in weight of antimony strips (microbrinell hardness 43±5) when brushed for 10,000 double strokes under a weight of 228 gm. with a slurry of Calcium Phosphate Tribasic U.S.P. Precipitated-Merck in 50 per cent v/v glycerin-water mixture to which gum tragacanth was added was 0.7 mg. Abrasiveness data were obtained in the A.D.A. Bureau of Chemistry, using a reciprocating brush-type machine. Other data listed above for Calcium Phosphate Tribasic U.S.P.-Precipitated-Merck were supplied by the firm.

Admission of a product to the list of Accepted Dental Remedies does not imply a recommendation. It means that the product and the methods by which it was marketed at the time of consideration were not found to be in violation of the Council's published rules. Accepted products are reconsidered periodically. The files of the Council contain information on many drugs and dental cosmetics. All information is available upon request and inquiries are welcomed. A postal card will bring a prompt reply.

DONALD A. WALLACE, *Secretary.*

*A.D.R. Ed. 8, p. 102
†A.D.R. Ed. 8, p. 87

REPORT OF NOMENCLATURE COMMITTEE

THIS report is the first of a series that the Nomenclature Committee proposes to publish. Succeeding reports on various other phases of dental nomenclature will be presented as soon as the material has been assembled and studied. It is hoped that, in due time, the collected reports from this committee will be made available to dental teachers, editors and authors. By this means, the duties of the Nomenclature Committee as outlined in the By-Laws of the American Dental Association—"to direct the development of scientific terminology related to dentistry"—may be fulfilled.

While notable progress has been made in certain aspects of dental literature in this country, dental nomenclature is still found to be in a more or less deplorable state. There appear to be a large number of poorly defined, etymologically hybrid terms currently used in dental literature. To add to the confusion, several different systems of terminology are used in various fields of dentistry.

Certain objectives in dental nomenclature seem to be desirable. If dental nomenclature is to be in keeping with the high classical and scientific esteem to which dentistry aspires, it should be of pure classical origins rather than made up of a collection of hybrid terms. Dental terms should not only be soundly developed etymologically, but should also be accurately defined. All scientific terms should preferably be fully informative and descriptive. On this basis, the use of eponyms (example: Riggs' disease) should be discouraged. An exchange of ideas and thoughts between individuals is possible only by the employment of a language of marked specificity.

It appears desirable also that unity of dental language be attained in this country. Unless this objective is realized, dental education and dental literature will continue to be characterized by confusion of thought and expression. In the realm of dental education, it is highly desirable that students of dentistry in all American schools be taught in a scientific language common to all. To the end that these objectives may be attained, the Nomenclature Committee solicits the profession's support and herewith presents the first of its reports. This report deals with periodontal nomenclature.

I. PERIODONTAL NOMENCLATURE

The last published American Dental Association report on nomenclature, which was presented by the 1937 Nomenclature Committee,[1] lists the following groups of words as synonyms:

(a) pericementum, peridentium, periodontium, peridental membrane.

(b) paradentium, parodontium.

(c) paradentosis, parodontosis, periodontosis.

(d) periclasia, periodontoclasia, parodontoclasia.

All of these terms are in use today and each has its proponents. This diversity of terms is not only aggravating and puzzling to many, but is obviously also a handicap to dental educators, students and authors. The following discussion is presented in an effort to clarify certain confusions.

Terms relating to the teeth are rooted in both Latin and Greek. The Latin word *dens* and the Greek *odous* serve as the keystones of dental nomenclature. To these roots may be added such prefixes and suffixes as are necessary to formulate words that are in themselves informative and descriptive and that can be accurately and logically defined.

The science of periodontology concerns itself basically with the so-called supporting or investing structures of the teeth. Two prefixes are in use to desig-

nate these tissues: *peri* and *para,* both of Greek origin. The prefix *peri* has enjoyed a longer use in this country. It was the only prefix used in the earlier phases of the American history of periodontology. The terms *periodontia, periodontology* and *periodontist* were originally formulated with no prevailing suggestion of etymologic controversy. The prefix *para* was seemingly popularized by the more recent appearance of numerous contributions to the American dental literature by European authors.

The prefix *peri* is used in medicine and anatomy to designate tissues that surround, encase or ensheathe, as in the terms *pericardium, periosteum and perivascular.* It is used to designate structures which surround or encase at a distance as well as those immediately contiguous.

The prefix *para* has a much wider use. In anatomy, it is used to designate structures that lie nearby or beside, as in the terms *parathyroid* and *parapineal.* In pathology, *para* is used to designate involvement of structures which lie nearby or beside, as *paracolitis* and *paramastitis.* It is also used in pathology to designate diseases that resemble other diseases, such as *dysentery* and *paradysentery, typhyoid* and *paratyphoid.* In chemistry, it is used to designate related compounds, such as *formaldehyde* and *paraformaldehyde.* It is also used to connote embryologic relationship, as *parovarium.* It is apparent that the prefix *para* is one of multiple inferences and is, therefore, not so accurately descriptive as the prefix *peri.*

If dental nomenclature is to be pure rather than hybrid in its origin, the Latin root *dens* should not be used with either of the Greek prefixes *peri* and *para.* Rather, the Greek root *odont* (from odous) should be employed.

Among the suffixes which may be employed in the construction of terms related to the subject of this report are the following:

itis: suffix of Greek origin indicating inflammation of the part to the name of which it is attached.

osis: suffix of Greek origin indicating disease in a broad general sense; a more limited meaning being degenerative disease (as nephrosis).

clasia: suffix of Greek origin meaning a breaking off, breaking down or destruction (as osteoclasia); used to indicate, in a non-specific manner, destructive disease without reference to nature or cause.

On the basis of the foregoing analysis, the following terms are recommended as preferable:

1. Periodontium: The investing and supporting tissues surrounding the tooth; namely, the periodontal membrane, the gingiva and the alveolar bone. Synonyms that the Nomenclature Committee recommends be discarded: parodontium, paradentium, peridentium.

2. Periodontal membrane: The fibrous tissue that connects the cementum of the tooth to the surrounding structures. Synonyms: periodontal ligament, pericementum. Synonym that the Nomenclature Committee recommends be discarded: peridental membrane.

3. Gingiva: The fibrous tissue, covered by mucous membrane, that covers the alveolar processes of the jaws and surrounds the necks of the teeth; the gum.

4. Gingival sulcus: The sulcus around a tooth, bounded internally by the surface of the tooth, and externally by the epithelium lining the free gingiva. Synonym: gingival trough. Synonym that the Nomenclature Committee recommends be discarded: gingival crevice.

5. Alveolar bone: The alveolar processes of the maxillae and mandible.

6. Alveolus, dental: The cavity or socket in the alveolar process in which the root of a tooth is held by the periodontal membrane. (In general anatomic nomenclature, the term is used to designate a cavity, air sac [lung] or acinus of a gland.)

7. Periodontology: The science and study of the periodontium and periodontal diseases.

8. Periodontia: The branch of dentistry that deals with the science and treatment of periodontal diseases. Synonym: periodontics.

9. Periodontist: One who is learned in the science of periodontology and skilled in treatment of periodontal diseases.

10. Periodontitis: Inflammatory disease of the periodontium. The condition may be further defined and described by such adjectives as acute, chronic, simple, ulcerative, purulent, etc. Periodontitis simplex, secondary to gingivitis. Periodontitis complex, secondary to periodontosis. Synonyms that the Nomenclature Committee recommends be discarded: parodontitis, peridentitis, paradentitis.

11. Periodontosis: Degenerative disturbance of the periodontium, characterized by degeneration of connective tissue elements of periodontal membrane and bone resorption. Synonyms that the Nomenclature Committee recommends be discarded: parodontosis, paradentosis, peridentosis, diffuse alveolar atrophy.

12. Periodontal atrophy: Atrophy of gingiva, periodontal membrane and alveolar bone. A type of periodontosis.

13. Periodontal traumatism: Injury of periodontium due to excessive occlusal, operative, accidental or orthodontic stress.

14. Periodontoclasia: Term to indicate non-specifically and collectively all destructive and degenerative diseases of the periodontium. Synonyms that the Nomenclature Committee recommends be discarded: pyorrhea alveolaris, Riggs' disease.

15. Gingivitis: Inflammation of the gingiva.

16. Gingival pocket: Pathologic sulcus about a tooth, deeper than the normal gingival sulcus. Synonym: periodontal pocket.

17. Gingival hypertrophy: Increase in size of gingival tissues; gingival hyperplasia.

The foregoing terminology is in accord with that recommended by the American Academy of Periodontology and adopted as official by that body for its transactions. This report is based in great part on the work of the Nomenclature Committee of the American Academy of Periodontology. The last report from that committee[2] has been freely used as source material. Many others, too numerous to mention, have also contributed to this report. The committee's debt and gratitude to these and to the 1942 Nomenclature Committee is acknowledged.

HARRY LYONS, *Chairman.*

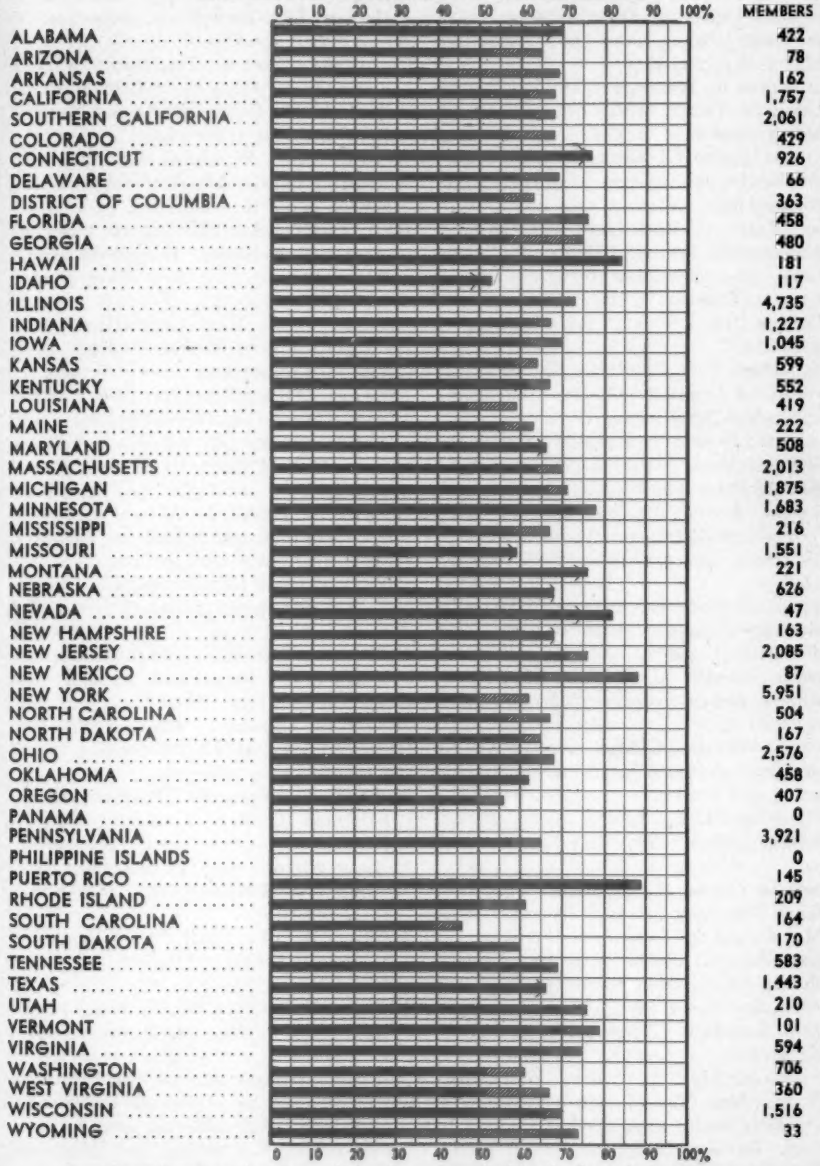
REFERENCES

1. Dental Terms Recommended by the Committee on Nomenclature of the American Dental Association. Tr. A.D.A., 1937, pp. 261-270.

2. Report of Nomenclature Committee. *J. Periodontol.*, 12:16-18, January 1941.

Membership Page

PERCENTAGE OF DUES RECEIVED IN CENTRAL OFFICE AS OF MAY 30, 1943, AS COMPARED TO 1942 MEMBERSHIP



Percentage based on dental population figures supplied by the State Society Secretaries.

1943 percentage 1942 percentage

DEATHS

ANDERSON, IVAR E., Milwaukee, Wis.; Northwestern University Dental School, 1917; drowned June 13, 1942 (body recovered May 1, 1943); aged 46.

BAIN, PETER B., Washington, D. C.; National University Dental Department, 1898; died May 1; aged 66.

BALDWIN, FRANK G., Orange, Conn.; Philadelphia Dental College, 1896; died April 18; aged 68.

BEAN, FRED A., Rockville Centre, N. Y.; University of Pennsylvania School of Dentistry, 1902; died May 16; aged 63.

BOUTWELL, CLINTON W., Boston, Mass.; Tufts College Dental School, 1898; died May 2; aged 67.

CAMP, MARK OTIS, Charleston, W. Va.; University of Louisville School of Dentistry, 1916; died April 29; aged 50.

CAMPBELL, NOBLE C., Erie, Pa.; University of Pennsylvania School of Dentistry, 1898; died April 23; aged 68.

COCHRAN, JOSEPH B., New Boston, Ohio; formerly of Cincinnati; Cincinnati College of Dental Surgery, 1892; died May 2; aged 74.

COLLINS, ROBERT G., Greenwich, N. Y.; Harvard University Dental School, 1906; died May 4; aged 59.

COUSINS, FORREST A., Guilford, Me.; Philadelphia Dental College, 1898; died May 15; aged 74.

DALBY, WILLIAM CURTIS, Azusa, Calif.; practiced dentistry in China for twenty years; died April 30.

DAVENPORT, M. E., Beverly, Mass.; Boston Dental College, 1889; died May 5; aged 74.

EDMONDS, GEORGE L., Rockville, Md.; National University School of Dentistry; died May 8; aged 69.

ENGEL, ADOLPH, Philadelphia, Pa.; University of Pennsylvania School of Dentistry, 1897; died May 2; aged 65.

EPLING, LUTHER C., Narrow, Va.; died April 29; aged 63.

FUTTERMAN, MAX J., Bronx, New York, N. Y.; New York University School of Dentistry, 1923; died May 8; aged 42.

GEHAN, RAYMOND F., Sacramento, Calif.; University of California School of Dentistry, 1910; died May 14; aged 54.

GILMAN, HARRY S., Wellesley Hills, Mass.; Harvard University Dental School, 1896; died May 8; aged 70.

GROSVENOR, EDWIN THORINGTON, White Plains, N. Y.; formerly of Detroit, Mich.; Pennsylvania College of Dental Surgery, 1891; died May 1; aged 84.

HAMILTON, GAIL WASHBURN, Council Bluffs, Iowa; Northwestern University Dental School, 1900; died April 27; aged 77.

HART, CHARLES S., Lake Geneva, Wis.; formerly of Evanston, Ill.; Northwestern Dental School, 1903; died May 14; aged 74.

HEDRICK, ORIAN RAY, Cumberland, Md.; Atlanta-Southern Dental College, 1910; died May 10; aged 50.

HERBHOLD, OTTO, New York, N. Y.; New York College of Dentistry, 1896; died May 5; aged 66.

HURDLE, C. E., Quincy, Ill.; Keokuk Dental College, 1904; died April 29; aged 62.

LURTING, ALEXANDER N., Mars, Pa.; University of Pittsburgh School of Dentistry, 1907; died April 18; aged 64.

LUTTON, WARREN H., Chicago, Ill.; Chicago College of Dental Surgery, 1911; died April 25; aged 63.

MCGOVERN, JOSEPH T., Dorchester Center, Mass.; Boston Dental College, 1891; died April 8; aged 73.

MCGREGOR, GEORGE F., Chicago, Ill.; Chicago College of Dental Surgery, 1910; died April 2.

MCLANE, FREDERICK C., Paterson, N. J.; Baltimore College of Dental Surgery, 1897; died May 17.

MCLEAN, GEORGE O., St. Petersburg, Fla.; formerly of Hartford, Conn.; died March 11; aged 83.

MCNAIR, DAN P., Ozark, Ala.; Vanderbilt University, School of Dentistry, 1914; died March 27.

MANGAN, THOMAS J., Seneca Falls, N. Y.; New York College of Dentistry, 1900; died April 15.

MARSHALL, WILLIAM ARTHUR, Salt Lake City, Utah; University of Denver Dental College, 1903; died April 24; aged 65.

MARTIN, JOHN E., Altoona, Pa.; University of Pittsburgh School of Dentistry, 1924; died April 26; aged 41.

MEEKS, MALONE MILTON, Canadian, Texas; died February 24; aged 65.

MERTZ, JOSEPH N., Siegersville, Pa.; Pennsylvania College of Dental Surgery, 1905; died April 28; aged 58.

METSKER, CLYDE H., Seattle, Wash.; Indiana University, School of Dentistry, 1900; died March 15; aged 66.

MILLS, JOHN A. D., Natick, Mass.; Boston Dental College, 1895; died April 10; aged 79.

MOLYNEAUX, WILLIAM M., Chino, Calif.; died March 25; aged 78.

MORIN, NOAH L., Fall River, Mass.; Baltimore College of Dental Surgery, 1915; died April 7.

MURPHY, ARCH J., Philadelphia, Pa.; died April 7; aged 71.

NAFF, W. E., Greeneville, Tenn.; Columbian University Dental Department, 1898; died March 28.

NATIONS, HUGH S., East St. Louis, Ill.; Washington University School of Dentistry, 1901; died May 12; aged 65.

NELSON, J. EMIL, Multnomah, Ore.; Indiana University School of Dentistry, 1903; died April 21; aged 66.

NORTH, CHAUNCEY L., Chillicothe, Ohio; Ohio State University, College of Dentistry, 1916; died April 14; aged 48.

O'BRIEN, LEO F., St. Louis, Mo.; St. Louis University School of Dentistry, 1913; died April 12; aged 65.

O'HARA, JAMES A., Beaver Dam, Wis.; died March 25; aged 61.

PHEANIS, CLIFFORD C., Major, Dental Corps, U. S. Army; Versailles, Ohio; Ohio College of Dental Surgery, 1924; died January 4.

PONTIUS, BERT B., West Los Angeles, Calif.; Western Reserve University, School of Dentistry, 1906; died February 24; aged 66.

RANKIN, DOKE N., Groesbeck, Texas; died May 3; aged 63.

REED, A. N., Eldora, Iowa; died March 21.

RICH, ALBERT C., Whitehall, Ill.; Northwestern University Dental School, 1908; died May 1; aged 63.

ROBERTS, FRANKLIN B., East Liberty, Pa.; University of Pennsylvania, School of Dentistry, 1898; died March 24; aged 67.

ROBINSON, WIP, Upper Valley, Texas, formerly of El Paso; Southern Dental College, 1897; died April 2; aged 70.

ROSCOE, VICTOR B., Wilkes-Barre, Pa.; Temple University School of Dentistry, 1924; died April 21.

RUND, CHARLES H., Jamaica Plain, Mass.; died April 30; aged 70.

SAWYER, FREDERICK A., Arlington, Mass.; Boston Dental College, 1890; died March 18.

SEITZ, WILLIAM J., Toledo, Ohio; University of Michigan, School of Dentistry, 1909; died April 29; aged 59.

SEYDEL, ROBERT A., Littleton, Colo.; formerly of Craig, and Idaho Springs, Colo.; died March 13; aged 57.

SHULL, WILLIAM HAMILTON, Kansas City, Mo.; died April 6; aged 85.

SMATHERS, HENRY A., Canton, N. C.; died March 28; aged 94.

SMITH, MILO V., Winchester, Ind.; Indiana Dental College, 1896; died April 7.

SMITH, W. E., Logan, Idaho; University of Southern California School of Dentistry, 1917; died March 19; aged 54.

SPEISMAN, LEO DENT, Troy, Ohio; Ohio State University, College of Dentistry, 1915; died May 8; aged 51.

STACY, F. A., Grenada, Miss.; University of Louisville School of Dentistry, 1912; died April 6.

STARKE, PARKE P., Ashland, Va.; Baltimore College of Dental Surgery, 1887; died April 30; aged 80.

STOWERS, JOHN R., Kansas City, Kan.; Western Dental College, 1900; died April 25; aged 70.

SWEENEY, JOHN J., Flushing, N. Y.; New York College of Dentistry, 1897; died April 16; aged 77.

TAINTER, GEORGE W., St. Charles, Mo.; Indiana University School of Dentistry, 1885; died March 26; aged 101.

TELLMAN, GARRETT HENRY, Muskegon, Mich.; Northwestern University Dental School, 1905; died May 6; aged 69.

TESCH, CLAUDE O., Kansas City, Mo.; Kansas City-Western Dental College; died April 28; aged 65.

THOMPSON, WILLIAM M., Red Bank, N. J.; University of Pennsylvania School of Dentistry, 1896; died April 12; aged 64.

TIMBERLAKE, ADDISON R., Clarksburg, W. Va.; Baltimore College of Dental Surgery; died May 4; aged 76.

TIPTON, W. R., Mount Carroll, Ill.; died March 26; aged 83.

UNDERWOOD, PHILIP RICHARD, Brooklyn, N. Y.; Columbia University School of Dental and Oral Surgery, 1929; died February 15; aged 46.

VAN RIPER, WALTER R., Paterson, N. J.; died April 18.

VIETOR, EDWARD C., Grand Rapids, Mich.; died April 14; aged 65.

VORHEES, FRANK H., Chicago, Ill.; Northwestern University Dental School, 1916; died February 20; aged 58.

WALKER, ARTHUR WILLIAM, Sebastopol, Calif.; died April 26.

WARFIELD, ROBERT C., Rockville, Md., Baltimore College of Dental Surgery, 1885; died April 6; aged 81.

WATKINS, L. LEROY, Hagerstown, Md.; Baltimore College of Dental Surgery, 1903; died April 30; aged 60.

WATSON, ROBERT S., Orange, N. J.; New York College of Dentistry, 1896; died in January.

WEARSTLER, HOWARD O., Barberton, Ohio; Western Reserve University School of Dentistry, 1902; died March 23; aged 67.

WELLS, CLAUDE C., Springsville, Iowa, formerly of Shenandoah, Iowa; State University of Iowa College of Dentistry, 1919; died recently; aged 49.

WELCH, JAMES R., Peoria, Ill.; Northwestern University Dental School, 1908; died November 19, 1942; aged 67.

WETTENGEL, HARRY M., Rockford, Ill.; Chicago College of Dental Surgery, 1902; died March 25; aged 61.

WHITFORD, OTIS B., Plainfield, N. J.; University of Buffalo, School of Dentistry, 1901; died June 1942.

WILLSON, W. H., Winter Park, Fla.; formerly of Brooklyn, N. Y.; University of Buffalo School of Dentistry, 1899; died February 5; aged 71.

WITHERSPOON, EDWIN J., Detroit, Mich.; died March 29; aged 75.

WOOD, J. HARRY, Lexington, Ky.; University of Louisville, School of Dentistry, 1900; died January 30; aged 69.

WOODS, REDMAN H., Hunnewell, Mo., formerly of Hannibal, Mo.; died February 24; aged 64.

WRING, WILBUR J., Hibbing, Minn.; Marquette University Dental School, 1915; died February 25.

YAGER, NEWTON THOMAS, Lexington, Ky.; University of Louisville, School of Dentistry, 1898; died March 3; aged 70.

YATES, GEORGE N., Durham, N. C.; Baltimore College of Dental Surgery; died April 17; aged 50.

ZACK, MAURICE R., Duluth, Minn.; University of Minnesota College of Dentistry, 1913; died April 24.

INCIDENTS OF PRACTICE

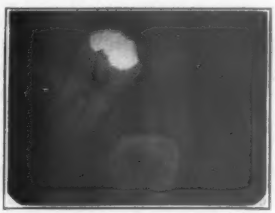
Buccolingual Impaction of a First Molar

By Morris H. Bernards, D.D.S., Chicago, Ill.

A young woman complained of severe pains in the lower right bicuspid area radiating into the region of the mandibular articulation and the ear.

Clinically, examination disclosed no deformity except a slight thickening on the buccal side in the region of the lower right first molar. A deciduous second premolar and the third molar had been extracted on this side in the hope of curing this ticlike pain.

A roentgenogram of the affected area



Buccolingual impaction of right first molar.

revealed an impacted first molar lying in an absolutely buccolingual position.

When the mandible was opened under local anesthesia, it was discovered that the impacted molar was lying directly across the mandibular nerve, and, in addition, had caused such erosion of the second bicuspid that it too had to be extracted.

Recovery was uneventful, and, in a period of three weeks, all pain in that area disappeared.

One would assume from this that the metallic element remained within the plastic, and, when exposed to ammonium polysulfide, the sulfide molecule was picked up by the metallic element.

Mercuric sulfide was then suspected, since aqua regia is the reagent for breaking down this compound.

In checking with the technician, it was found that all the acrylics used had been made in the the presence of mercury. Several brands of acrylics were used, but, in every case, the wax pattern had been drawn from a silver amalgam die. Upon examining these wax patterns, I found mercury present on the cavity side of the wax pattern.

In removing the wax from the mold, traces of mercury were found to remain in the mold, this fact accounting for the presence of mercury in the acrylic.

Since mercury vaporizes some at room temperature, the mercury, when introduced to hot wax, comes quickly to the surface and contaminates the plastic mixture.

As the human diet is composed of many sufides, it is no wonder that the two elements join to form the dark compound in acrylics, mercuric sulfide.

Various cements were also used in cementing these acrylics, and, as might be assumed, the presence of cements containing mercury seemed to hasten the discoloration.

4005 West North Avenue.

Acrylic Replacements of Broken Pin Facings

By J. Dexter Eoff, D.D.S., Ballinger, Texas

In acrylic replacements of broken pin facings, the remaining porcelain is removed, the pins being injured as little as possible. This may be done with chisels or in any other manner that is suitable for the case at hand. The pins are then removed from the porcelain fragments or from the gold "backing" in a manner to preserve them in as good

a condition as possible. If they can be recovered in a usable condition, they will serve for the pins in the acrylic replacement. The gold backing is cleaned and the pin holes freed of cement preparatory to making a wax pattern.

If the original pins are in a usable condition and fit snugly into the holes, they can be utilized, but if they have been injured or if they fit too closely in the holes, new pins should be made. A length of gold orthodontic wire or a suitable wire of a non-tarnishing type should be slected of a diameter to fit the holes in the backing closely. A small portion of one end should be hammered until it is flat and then bent over at a right angle for retention in the acrylic prosthesis. It is now cut to the proper length. Two such pins are formed and placed in position in the holes of the gold backing. If necessary, they may be fastened in position with wax, but they should not be sealed to the gold. If the holes do not extend all the way through the gold, it will not be necessary to fasten the pins in place.

With the pins in place, a suitable portion of inlay wax is compressed over the gold and into all places that should be covered by the acrylic inlay. The wax is chilled and carved to the desired shape. When possible, a small excess should be left extending over the margins.

The finished wax pattern is removed from the bridge and invested as in any other acrylic process, with the pins extending into the investment. The second half of the investment is poured, and when set is removed from the first half without heating. The wax corresponding to the area to be included in the incisal color is removed with suitable carvers and a second "second half" is poured. This, of course, necessitates the use of a flask with duplicate top rings. The case is now boiled and cleaned, being thoroughly flushed with a suitable solvent to remove all traces of wax and pigment. When the solvent has dried, a coating of a suitable separating material similar to that furnished with some of the acrylic outfits is applied over the surface of the part of the mold formed in the first part of the investment.

The proper blends of the material are prepared and that corresponding to the gingival color is pressed, using the second "second half." This is "cured" for a few minutes to keep it from being forced out of place when the incisal blend is added. When the case is separated and the first part of the material is partially hardened, the incisal color is added and the flask is closed, the first "second half" being used. The case is now processed according to directions. When cool, it is separated and trimmed carefully to remove any excess material, then polished lightly where necessary, and the facing is ready to be tried in for final correction. When it is satisfactory, it is cemented in the usual manner.

F. & M. State Bank Building.

CURRENT LITERATURE

Journal of Oral Surgery
April, 1943

Titles marked with an asterisk (*) are reviewed below.

*Surgery of the Face, Mouth and Jaws, Thirty Years Ago and Now. Robert H. Ivy, M.D., D.D.S., Philadelphia, Pa.—95.

*Osteofibroma of the Mandible Associated with Leontiasis Ossea of the Skull: Report of a Case. G. Victor Boyko, D.D.S., Paterson, N. J.—100.

*Anatomic Considerations in Local Anesthesia. W. H. Phillips, D.D.S., M.S., Detroit, Mich.—112.

*Fractures of the Maxillae. Douglas B. Parker, M.D., D.D.S., New York, N. Y.—122.

*Vitallium Bone Screws and Appliances for Treatment of Fracture of the Mandible. Harry M. Bigelow, D.D.S., Fort Devens, Mass.—131.

*Cysts of the Maxilla and Mandible, Diagnosis and Treatment. Kenneth W. Penhale, D.D.S., M.D., Chicago, Ill.—138.

*Fracture of the Edentulous Mandible. Joseph A. Doherty, D.M.D., LL.B., B.S., M.S., Boston, Mass.—157.

*Non-Union in Fracture of the Mandible, with Report of a Case. Homer L. Skinner, M.D., F.A.C.S., and R. L. Robinson, D.D.S., Baltimore, Md.—162.

*Asphyxia in Oral Surgery. Paluel J. Flagg, M.D., New York, N. Y.—168.

*The Dentist and the Bronchoscope. Lyman G. Richards, M.D., Boston, Mass.—174.

*Severe Facial Injury of Unusual Etiology: Report of a Case. L. Roy Johnson, D.M.D., Greenfield, Mass.—179.

Book Notices and Reviews.

Current Literature—Abstracts.

Surgery of the Face, Mouth and Jaws, Thirty Years Ago and Now

A COMPARISON of present and past treatment in oral and plastic surgery is made. Progress has been in diagnosis and treatment. Changes noted include the fields of shock, anesthesia, x-ray, interdental ligation and skeletal fixation for fractures, bone grafting, cleft lip and palate and tumor treatment. Mention is made of improvements in dental education which prepare the dentist for extended service and furnish the groundwork for the development of oral surgeons. The opinion is expressed that "the time is coming when hospital internship will be a requirement for the practice of dentistry."

Osteofibroma of the Mandible Associated with Leontiasis Ossea of the Skull: Report of a Case

THE term osteofibroma as here used is synonymous with localized osteitis fibrosa, fibroma, localized Paget's disease, fibro-osteoma and fibrous osteoma. It is suggested that the stage at which the tissue is examined causes the variations in pathologic terminology as applied to the disorder. Leontiasis ossea is the name here given to tissue changes "affecting the bones of the face and skull which undergo a varying diffuse hyperostosis with an associated thickening and sclerosing of its many bone sections." Roentgenographically, leontiasis ossea shows increased bone density and thickness without the "cotton-wool" appearance of Paget's disease. The case report describes a combined osteofibroma and leontiasis ossea in a woman, aged 32. The chief complaint was a feeling of pressure and fulness in the mandible. The family history was negative. The past history included scarlet fever, pains in the legs, with erythema nodosum, anemia and a "nervous breakdown." Clinically, there was fulness of the right body of the mandible and prominence of the bridge of the nose and the frontal and temporal bones. Laboratory test revealed a high blood calcium. Roentgenograms showed a rounded tumefaction of the affected mandible and a density of some of the bones of the skull, with accompanying circumscribed areas of rarefaction. Biopsy of the mandible revealed the osteofibroma. X-ray treatment of the jaw was followed by complete liquefaction at the site of the biopsy, with spontaneous fracture. Immobilization over a long period permitted bony union.

Anatomic Considerations in Local Anesthesia

THE success of local anesthesia depends

on the ability of the operator to place the solution in as close contact with the nerves as possible. This, in turn, is dependent on anatomic knowledge. Information regarding nerve anastomosis and the possibilities of multiple innervation is essential. Numerous technical suggestions which aim at improving anesthesia of the jaws and pulps of teeth include the following: Injection of the nasopalatine nerve through the foramen of Scarpa is needed for anesthesia of the maxillary incisors in addition to infiltration of the anterior superior alveolar branch. The subperiosteal approach is superior to the supraperiosteal for anesthetizing pulps of maxillary teeth. Infiltration on the inner aspect of the lower incisor teeth is sometimes needed to supplement inferior alveolar block because of the rare possibility of mylohyoid innervation. The lower bicuspids may need infiltration on the lingual surface for interruption of cutaneous coli branches. Inferior alveolar block injections must be directed in a more directly downward course in children than in adults. A nerve block injection down to the temporal muscle sheath on the buccal aspect of the ramus at the level of occlusion of the teeth effectively disposes of the buccinator nerve.

Non-Union in Fracture of the Mandible, with Report of a Case

STATED causes of non-union are: separation of the line of fracture by interposition of tooth roots; late reduction; extensive loss of bone, and osteomyelitis and necrosis. Onlay bone grafts are considered superior to bone wiring, inlay grafts and plating. For extensive replacements, the best source of new bone may be the crest of the ilium, but not for smaller, non-united defects. Full thickness onlays from the tibia are best for the latter. The dental immobilizing splint should be worn for a few days before operation to determine whether it will be comfortable.

Fractures of the Maxillae

MOST maxillary fractures are transportation injuries. Explosive and projectile penetrations of the maxillae are more apt to be fatal if directed anteroposteriorly. Nasal bones, orbits, antra, palate bones and malars are frequently involved. Malocclusion and mobility of the maxilla are usually diagnostic signs. Roentgenographic assistance is necessary, but is not always conclusive. Postero-anterior films and stereoscopic views are most valuable. Ordinary muscle pull does not cause displacement. Early irrigation of the sinuses is unnecessary. Reduction depends on the diagnosis. Chin traction and interdental ligation are utilized and reverse Kingsley splints and plaster headcaps with attached traction anchorages are used as needed. Surgical prothesis is valuable in some cases for soft tissue support.

Vitallium Bone Screws and Appliances for Treatment of Fracture of the Mandible

THE author believes that vitallium screws which are placed in the mandible and attached to an external bar furnish an immobilizing agent superior to direct bone wiring, circumferential wiring, etc., for fractures of edentulous lower jaws or distally from the last lower molar tooth. It is suggested that a football helmet can be adapted for use as a carrier of traction wires and attachments. The author's vitallium screws and bars can be obtained from the manufacturers of vitallium.

Cysts of the Maxilla and Mandible, Diagnosis and Treatment

ON the classification, diagnosis and treatment of cysts of the jaws, lipiodol on gauze is frequently used to assist roentgenographic diagnosis. Large cysts of the maxillae present difficult problems, but anterior or low ones are more easily diagnosed than those near the tuberosity. Sometimes, the Caldwell-Luc operation through the canine fossa is used. The cyst membrane is made continuous with that of the sinus, an opening into the nose is created under the inferior turbinate and the wound is closed intraorally. Traumatic bone cysts have no epithelial linings and should be observed by the x-rays without operation for a period of time. Preference is given for the Partsch type of operation in large cysts of both jaws, where complete eradication is not always desirable. In these cases, wound packing until the external opening can maintain itself is necessary. After a period of time, with frequent roentgenographic examination, the cyst can be removed if it has become sufficiently reduced in size. To pre-

vent fractures where large cysts of the mandible are present, it may be well to insert splints.

Fracture of the Edentulous Mandible

THE Gunning method for treatment of fractures of the edentulous mandible should be reserved for simple cases. The use of circumferential wires about a splint resting on the alveolar ridge is very practical. Direct bone wiring, intra-orally, is satisfactory. Skeletal fixation presents no advantages not enjoyed by circumferential or direct bone wiring.

Severe Facial Injury of Unusual Etiology: Report of a Case

THE patient received a maxillary and skull fracture in an unusual manner. A partially fallen tree, while being sawed in two, fractured in the greenstick manner and the woodsman's head was caught in the crack as the split section snapped back into place. The treatment was of the usual type, utilizing a plaster headcap, coat-hanger wires, Kingsley appliance, intra-nasal splint and rubber traction, with apparently excellent results.

The Dentist and the Bronchoscope

FOREIGN bodies of dental origin occasionally get into the trachea. Teeth, bridges, dental instruments, etc., are the usual offenders. Abnormal cyanosis or a spasmodic cough should lead one to suspect possible inspiration of a foreign body, even before complete reaction from anesthesia. Such symptoms call for immediate x-ray examination of the chest. If anything is found, prompt bronchoscopy is indicated.

Asphyxia in Oral Surgery

THE four types of asphyxia which may be encountered by the oral surgeon are: 1. Anoxic anoxia, the obstructive or insufficient oxygen availability type. 2. Anemic anoxia, wherein the blood-carrying capacity is reduced. 3. Stagnant anoxia, which is caused by poor circulation. 4. Histotoxic anoxia, developed by inability of the cells to absorb and utilize the available oxygen because of chemical poisoning. It is essential to recognize the last three because superimposition of the first might be fatal although the patient may tolerate chronic anoxia if not further burdened. The avoidance of anoxic anoxia is determined by the skill of the anesthetist in the use of such agents as suction tubes. The stages and signs of asphyxia may easily be recognized. The operator must be familiar with the means of extrication from anoxic difficulties. The laryngoscope, endotracheal suction apparatus, oxygen and carbon dioxide should be at hand.

Journal of Dental Research

April 1943

Titles marked with an asterisk (*) are reviewed below.

*Penetration of Silver Nitrate Solution into Dentin. H. A. Zander and Dan Y. Burrill (Northwestern University)—85.

*Existence of Cuticular Structures on Human Teeth. Irving Glickman and Basil G. Bibby (Tufts College)—91.

*Filamentous Microorganism Isolated from Stained Teeth. Henry A. Bartels (Columbia University)—97.

Incidence of Urease Producing Bacteria in Saliva. M. K. Hine and J. F. O'Donnell (University of Illinois)—103.

*Studies on the Incidence and Cause of Dental Defects in Children. I. Prophylaxis. Marcu Brucker (Board of Education, Newark)—107.

*Studies on the Incidence and Cause of Dental Defects in Children. II. Hypoplasia. Marcu Brucker (Board of Education, Newark)—115.

*New Micro-Method for the Determination of Fluorides. Saul M. Bien (New York State Psychiatric Institute and Hospital)—123.

*Fluoride Domestic Waters and Dental Caries Experience in 2,026 White Illinois Selective Service Men. Charles F. Deatherage (State Department of Public Health, Illinois)—129.

*Further Studies of the Calcium and Phosphorus Content of Resting and Activated Saliva of Caries-Free and Caries-Active Individuals. H. Becks, W. W. Wainwright and D. H. Young (University of California)—139.

*Variations in the pH of Saliva of Five Individuals. L. L. Eisenbrandt (University of Kansas City)—147.

Analysis of Oral Reactions to Dilantin-Sodium. Leo Stern, Leon Eisenbud and Jack Klatell (Mt. Sinai Hospital, N. Y.)—157.

Penetration of Silver Nitrate Solution into Dentin

HOWE'S ammoniacal solution of silver

nitrate was applied to cavities in sound human teeth and to cavities cut in dogs' teeth and the effects of variations in duration of application, and time elapsing between the precipitation and extraction of the tooth, studied. It was found that variations in the duration of application of the solution do not appreciably affect the depth of penetration. When the tooth was extracted immediately after precipitation of the silver nitrate solution, the penetration was to only a limited depth in the dentin; while if the tooth was left in place for a month after precipitation, the particles of precipitate from the silver nitrate solution had penetrated through the sound dentin and into the pulp. It is suggested that the particles may have been carried through the dentin by the dental lymph. Particles reaching the pulp cause some change in the pulp, but did not cause sufficient irritation for concern.

Existence of Cuticular Structures on Human Teeth

A STUDY of approximately 1,400 decalcified sections of sixty-four erupted teeth *in situ* in human adult jaws offered an opportunity to determine whether cuticular structures actually exist in relation to the teeth and periodontal tissues. The term "enamel-cuticle" is suggested for the cuticle that is constantly found on the enamel only in both erupted and unerupted teeth. The term "transposed-crevicular cuticle" is suggested for the cuticle that is derived from the epithelium of the gingival crevice and is transposed upon the tooth surface in the course of eruption. It was observed in approximately 50 per cent of the cases studied. The latter cuticle is most commonly seen on the cementum, but may also exist on the crown externally from the enamel cuticle.

It is suggested that when the cementum is exposed by periodontoclasia and secondarily involved by caries, the enamel cuticle possesses a greater surface protective action than does the transposed-crevicular cuticle.

Filamentous Microorganism Isolated from Stained Teeth

A FILAMENTOUS micro-organism present in a brownish stained deposit adherent to the enamel of a man's anterior teeth was successfully isolated on blood-agar plates incubated anaerobically. Its morphologic, cultural and fermentative properties were studied. Dissociation of the rough tenacious aborescent colony type to a smooth moist colonial form occurred on starch-agar. The aborescent colony consisted of filaments, while the smooth colony contained mainly diphtheroid forms with very few filaments. Fermentative reactions were similar for both forms of colony growth. Attempted reversion of the smooth to the rough colony form was unsuccessful. Neither type was found pathogenic for guinea-pigs or mice. Since the micro-organism possessed some characteristics familiar to both leptotrichia and actinomyces, its identification was difficult. The confusion existing in the classification of filamentous micro-organisms of the oral cavity is stressed in a discussion of the recent literature on the subject.

Studies on the Incidence and Cause of Dental Defects in Children. I. Prophylaxis

THIS study of 5,103 public school children of Newark, N. J., showed that a state of good dental health, established through natural resistance to caries or through reparative work, is more definitely associated with clean than with dirty teeth.

Of the white girls with clean teeth, 30 per cent did not show the presence of active caries, but only a little more than 4 per cent of the white girls having dirty teeth failed to show dental decay. While 33 per cent of the white boys with clean teeth showed no active caries, only a little more than 12 per cent of those with dirty teeth presented no signs of the disease. The percentage of colored boys and girls free from active caries was larger among those with clean teeth than among those with dirty teeth.

A study of tooth brushing habits established the fact that more pupils were caries free in the group who brushed their teeth daily than in the group who brushed their teeth occasionally or in those who never did.

Studies on the Incidence and Cause of Dental Defects in Children. II. Hypoplasia

THIS study of 1,921 public school pupils of Newark, N. J., showed that there is no relationship between caries and such structural defects as hypoplasia. Of a total of

28,924 permanent teeth examined, 216 were hypoplastic. Of these, forty-four showed caries and 172 were free from caries. The permanent teeth that showed dental decay were nearly eleven times more numerous than those showing hypoplasia. Of a total of 14,735 deciduous teeth examined, 130 showed caries and 106 were free from caries. The deciduous teeth that showed caries were twenty-three times more numerous than those showing hypoplasia.

The influences that cause such variations in the two disorders obviously cannot have a common origin, and it is concluded that there is no relation between caries and hypoplasia.

New Micro-Method for Determination of Fluorides

SIMPLIFICATION in the distillation of samples containing from 1 to 10 gamma of fluorine results from the use of a modified Feigl distillation flask, which combines the receiver and flask in a single unit, concentrating the only source of moisture on the thorn of the ground-glass stopper.

A sample mixed with quartz sand is placed in the lower section of the distilling flask and concentrated sulfuric acid is added. The stopper, carrying a drop of water on the thorn, is quickly inserted. The contents are heated slowly and allowed to cool completely. The drop of water remaining on the thorn is washed into a small centrifuge tube, diluting the contents to 1 cc.

A distillate is prepared for titration with thorium nitrate by the addition of a buffer and an indicator. The use of an indigo carmine sodium alizarin sulfonate indicator permits the reading of a double end-point, one gray and the other violet, the second being used as a check on the first. Color changes are definite and clear. Losses on distilled samples run from 1 to 6 per cent.

Fluoride Domestic Waters and Dental Caries Experience in 2,026 White Illinois Selective Service Men

A STUDY of 2,026 white adults (selectees) lends further support to the fluorine dental caries hypothesis. The domestic waters used by these selectees were grouped into three broad divisions: fluoride free (0.0 to 0.1 parts per million of F.), suboptimal fluoride (0.5 to 0.9 parts per million) and fluoride (1.0 parts per million and over). Individuals were classified according to whether they had used the domestic water in question (a) during their entire lives, or (b) during the first eight years of life only (period of dental calcification).

The selectees who had lived their entire lives in areas where the public water supplies contained suboptimal fluoride (0.5 to 0.9 parts per million) had a total dental caries experience rate of 788, as compared with 1,079 for selecteees who had lived in fluoride-free areas their entire lives. Those selectees living the first eight years of their lives in these areas had a total dental caries experience rate of 887 as compared with 995 for the selectees who were born and had lived the first eight years of their lives in fluoride-free areas.

The selectees who had lived their entire lives where the public water supplies contained 1.0 parts per million and over of fluorides had a total dental caries experience rate of 621, as compared with a total rate of 1,079 for the selectees who had lived in fluoride-free areas their entire lives and the selectees who had lived the first eight years in these areas.

Further Studies of the Calcium and Phosphorus Content of Resting and Activated Saliva of Caries-Free and Caries-Active Individuals

TOTAL calcium and inorganic phosphorus were determined in salivary samples collected from one to three hours after breakfast with and without paraffin activation and in comparable groups of twenty-five caries-free and twenty-five caries-active individuals. Since differences in concept of clinical criteria for caries-activity and freedom, time of collection and type (resting or activated) of samples, and preliminary treatment have been considered to make comparison of previous studies difficult, studies of caries-free individuals were extended and all differences in approach eliminated.

The arithmetic means of all calcium and phosphorus in milligrams per hundred cubic centimeters and milligrams per hour values of resting as well as activated saliva of twenty-five caries-free and twenty-five caries-active individuals were found to be within the same range and not significantly different according to statistical evaluation, these

findings confirming the results of a previous report in which only resting saliva was used, in contrast to the experience of Karshan.

Variations in the pH of Saliva of Five Subjects

By means of the glass electrode, 276 determinations were made upon the pH of the saliva of five subjects. The tests were made five times daily for from ten to twelve days. The data were considered statistically for the group and the individual. The mean pH for the group was 6.72. The mean pH of saliva for each subject was 6.78, 6.59, 6.71, 6.66 and 6.84. Three of these were significantly different from the mean 6.72. The subjects were significantly variable one from another.

The group was significantly variable at bihourly intervals of 9 and 11 a. m. and 1, 3 and 5 p. m. The mean pH of saliva for each period was, respectively: 6.60, 6.76, 6.74, 6.70 and 6.79. Only the first and last were significantly different from the group mean. The subjects were significantly variable one from another at 9 o'clock and probably at 11 o'clock. No subject was significantly variable for the bihourly periods.

Prevention of Dental Caries by Brushing the Teeth with Fluorapatite

By J. F. McCLENDON and W. C. FOSTER

RATS on a caries-producing diet containing 0.3 parts per million of fluorine developed 3.3 cavities per rat in ninety days; while rats on the same diet having their teeth brushed every day with powdered fluorapatite developed 0.3 cavities per rat. In 100 days, the figures were 3.5 and 0.5 cavities per rat, respectively. The dentin in the molars of the brushed teeth contained eleven times as much fluorine as that in the unbrushed teeth. The increase in fluorine in the enamel was about five times. The more rapid growth and greater health of the rats that had the teeth brushed with fluorapatite indicated that some fluorapatite was swallowed.—*Federation Proc.*, 2:34, March, 1943.

DAVID B. SCOTT.

Storage of Fluorine in Human Bones and Teeth

By J. F. McCLENDON and W. C. FOSTER

ON an ordinary diet, two subjects excreted 1 mg. of fluorine per day in the urine. The dentin of two molars removed from one subject contained 0.019 and 0.033 per cent respectively. For a period of about a year, the subjects ingested 1 gm. of powdered fluorapatite containing 40 mg. of fluorine daily. During this period, two more molars were removed from the same subject. The dentin contained 0.042 and 0.047 per cent fluorine respectively. The urinary output of fluorine remained constant during the period of the experiment at levels varying between 8.4 and 11 mg. daily. The results indicate that since the amount of fluorine retained after ingestion is more than could be stored in the teeth, it is stored in the bones.—*Federation Proc.*, 2:33, March 1943.

DAVID B. SCOTT.

Surgical History of Trigeminal Neuralgia

By A. M. MEIROWSKY

The surgical treatment of tic douloureux has progressed through four period types of operative procedure: First period, 1800-1850 A.D.: operations on peripheral nerves: neurotomy, neurectomy, extraction of nerves, stretching. Second period, 1850-1890: operations on the gasserian ganglion, including partial or complete removal. Third period, 1890: operations on the sensory roots with preservation of the ganglion and the oculomotor division. Fourth period, 1936: new and still largely experimental operations directly on the tract in the brain-stem. Considerable success is achieved by use of the latter two types of operations.—*Arch. Neurol. & Psychiat.*, 49:574, April 1943.

DAVID B. SCOTT.

Sore and Bleeding Gums in Naval Personnel—Vitamin C and Nicotinic Acid Intakes

By C. C. UNGLEY and J. S. F. HORTON

FIFTY-ONE patients with sore and bleeding gums showed unsaturation with respect to ascorbic acid, but to no greater extent than healthy controls. Clinical evidence of scurvy was absent. Therapeutic administration of vitamin C was ineffective. The condition was apparently due to local conditions: infection, calculus and Vincent's infection (85 per cent of cases). No relationship to nicotinic acid deficiency could be demonstrated. —*Lancet*, 1:397, March 1943.

DAVID B. SCOTT.

ANNOUNCEMENTS

ANNOUNCEMENTS must be received by the fifth day of the month in order to be published in the forthcoming issue of THE JOURNAL.

CALENDAR OF MEETINGS

AMERICAN DENTAL ASSISTANTS ASSOCIATION, Cincinnati, Ohio, October 11-14.

AMERICAN SOCIETY OF ORAL SURGEONS AND EXODONTISTS, Cincinnati, Ohio, October 8-9.

DISTRICT OF COLUMBIA DENTAL SOCIETY, second and fourth Tuesdays in each month, from October to June, at the United States Public Health Service Auditorium, Washington.

MONTREAL (CANADA) DENTAL CLUB, October 20-22.

GREATER NEW YORK DENTAL MEETING, New York, December 6-10.

NEW YORK SOCIETY OF ORTHODONTISTS, New York, November 8-9.

ROOT CANAL THERAPY ORGANIZATION, Chicago, February 1944.

STATE SOCIETIES

September

Southern California, at Los Angeles (13-15)

November

Ohio, at Cleveland (7-10)

January 1944

Rhode Island, at Providence

STATE BOARDS OF DENTAL EXAMINERS

California, at San Francisco, October 25 and at Los Angeles, November 29. Kenneth I. Nesbitt, 515 Van Ness Ave., San Francisco, Secretary.

Indiana, at Indianapolis, August 23-26. Carl A. Frech, Gary State Bank Bldg., Gary, Secretary.

Iowa, at Iowa City, July 26-30. Harry G. Bolks, Sioux City, Secretary.

New Jersey, June 28-July 2. J. Frank Burke, 150 E. State St., Trenton, Acting Secretary.

North Dakota, at Fargo, July 12-15. R. A. Andrews, Carrington, Secretary.

Pennsylvania, at Philadelphia and Pittsburgh, October 19-23. Reuben E. V. Miller, 61 N. Third St., Easton, Secretary.

AMERICAN DENTAL ASSISTANTS ASSOCIATION

THE nineteenth annual session of the American Dental Assistants Association will be held in Cincinnati, Ohio, October 11-14, with headquarters at the Hotel Gibson.

AILEEN M. FERGUSON,
General Secretary,
709 Centre St.,
Jamaica Plain, Mass.

AMERICAN DENTAL HYGIENISTS' ASSOCIATION

THERE will be a special meeting of the House of Delegates and the Board of Trustees of the American Dental Hygienists' Association in Cincinnati, Ohio, October 10-13. Headquarters will be at the Hotel Gibson.

A. REBEKAH FISK, *Secretary,*
Arlington, Va.

AMERICAN SOCIETY OF ORAL SURGEONS AND EXODONTISTS

THE twenty-fifth annual meeting of the American Society of Oral Surgeons and Exodontists will be held at the Netherland-Plaza Hotel, Cincinnati, Ohio, October 8-9.

HARRY BEAR, *Secretary,*
410 Professional Bldg.,
Richmond, Va.

MONTREAL DENTAL CLUB FALL CLINIC

THE Nineteenth Annual Fall Clinic under the auspices of the Montreal Dental Club will be held at the Mount Royal Hotel, Montreal, Canada, October 20-22. For further information, apply to

M. L. DONIGAN, *Director,*
Drummond Medical Bldg.,
Montreal.

GREATER NEW YORK DENTAL MEETING

THE next Greater New York Dental Meeting will be held in the Hotel Pennsylvania, New York, December 6-10.

S. A. ISAACSON, *Chairman,*
Press and Publication Committee,
Room 106A,
Hotel Pennsylvania,
New York.

NEW YORK SOCIETY OF ORTHODONTISTS

THE fall meeting of the New York Society of Orthodontists will be held at the Hotel Waldorf-Astoria, New York, November 8-9.

NORMAN L. HILLYER, *Secretary,*
Professional Bldg.,
Hempstead, N. Y.

ROOT CANAL THERAPY ORGANIZATION

AT the Midwinter Meeting of the Chicago Dental Society, a national group for the study of root canal therapy was organized. W. Clyde Davis was made president, and John H. Hospers, secretary-treasurer. Committees were appointed to draw up a constitution and to select a name, to be submitted at the next regular meeting, in Chicago in February 1944. It is hoped that all those who are interested in this fundamental phase of dentistry will associate themselves with the group. Those joining before the final organization will be considered charter members. Annual dues were temporarily set at $2. All correspondence should be addressed to

JOHN H. HOSPERS, *Secretary,*
25 E. Washington St.,
Chicago, Ill.

SOUTHERN CALIFORNIA STATE DENTAL ASSOCIATION

THE next annual meeting of the Southern California State Dental Association will be held in Los Angeles, at the Ambassador Hotel, September 13-15.

ROBERT L. BORLAND, *Secretary,*
602 Chapman Bldg.,
Los Angeles.

BOARD OF DENTAL EXAMINERS OF CALIFORNIA

THE next examinations to be conducted by the Board of Dental Examiners of California for licensure in the State of California will be held in San Francisco commencing October 25 and in Los Angeles commencing November 29. All credentials must be in the office of the secretary, Room 203, 515 Van Ness Ave., San Francisco, at least twenty days prior to the examinations. Address all communications to

KENNETH I. NESBITT, *Secretary.*

OHIO STATE DENTAL SOCIETY

THE next annual meeting of the Ohio State Dental Society will be held in Cleveland, November 7-10.

EDWARD C. MILLS, *Secretary,*
255 E. Broad St.,
Columbus.

RHODE ISLAND STATE DENTAL SOCIETY

THE next meeting of the Rhode Island State Dental Society will be held in Providence in January 1944.

CHARLES F. MCKIVERGAN,
Secretary Pro Tem.,
102 Waterman St.,
Providence.

INDIANA STATE BOARD OF DENTAL EXAMINERS

THE next examination for a license to practice dentistry in Indiana will be held in Indianapolis, August 23-26. All credentials must be in the hands of the secretary at least ten days prior to the date of the examination. For application blanks and information, address

CARL A. FRECH, *Secretary,*
Gary State Bank Bldg.,
Gary.

IOWA STATE BOARD OF DENTAL EXAMINERS

(Change of Date)

THE Iowa State Board of Dental Examiners will hold its next examination at the College of Dentistry, State University of Iowa, Iowa City, July 26-30. Application with necessary fee must be in the hands of Mr. H. W. Grefe, director of licensure and registration, Iowa State Department of Health, Des Moines, fifteen days before the examination.

HARRY G. BOLKS, *Secretary,*
923 Badgerow Bldg.,
Sioux City.

NEW JERSEY STATE BOARD OF REGISTRATION AND EXAMINATION IN DENTISTRY

THE State Board of Registration and Examination in Dentistry of New Jersey will hold its next regular examinations commencing June 28 and continuing for five days. On application to the secretary, a copy of the requirements and rules, instruction sheet and preliminary application will be forwarded. Candidates were required to file the preliminary application blank, with the examination fee of $25, on or before March 15. Future schedules will be announced.

J. FRANK BURKE, *Acting Secretary,*
150 E. State St.,
Trenton.

NORTH DAKOTA STATE BOARD OF DENTAL EXAMINERS

THE North Dakota State Board of Dental Examiners will hold its next examination in the Gardner Hotel, Fargo, July 12-15. For further information and applications, address

R. A. ANDREWS, *Secretary,*
Carrington.

DENTAL COUNCIL AND EXAMINING BOARD OF THE COMMONWEALTH OF PENNSYLVANIA

THE Dental Council and Examining Board of the Commonwealth of Pennsylvania will meet in Philadelphia and Pittsburgh, October 19-23 to examine applicants for licensure to practice dentistry. For further information and application blanks, address the Department of Public Instruction, Bureau of Professional Licensing, Dental Division, Harrisburg.

REUBEN E. V. MILLER, *Secretary,*
61 N. Third St.
Easton.

VERMONT STATE BOARD OF DENTAL EXAMINERS

THE Vermont State Board of Dental Examiners will meet for the purpose of examining candidates in dentistry and dental hygiene, June 28-30, at the State House, Montpelier.

CHARLES I. TAGGART, *Secretary,*
139 Bank St.,
Burlington.

DENTAL INTERNSHIPS

THE Greater New York Conference of Hospital Dental Services, comprised of a group of men who are chiefs of dental services, would like to aid those men seeking dental internships in hospitals in the metropolitan area. Those who are not in the Army or the Navy and who are desirous of obtaining internships should communicate with

MARY E. REILLY, *Secretary,*
386 Fourth Ave.,
New York, N. Y.

DIRECTORSHIPS OPEN IN WEST VIRGINIA STATE HEALTH DEPARTMENT

UNASSEMBLED examinations are announced for positions in the West Virginia State Health Department. Applications will be accepted continuously, but new registers will be established from applicants who file no later than June 26. Positions for which applications are now accepted, together with salary ranges, are as follows: Director, Bureau of Dental Hygiene, $3,840-$4,500; Director, Public Health Education, $2,640-$3,240. Appointments may be made at above the minimum salaries. Residence in West Virginia has been waived in consideration of applicants for these positions. Address communications to

ROBERT F. BINGHAM, *Supervisor,*
212 Atlas Bldg.,
Charleston.

VOLUNTEERSHIPS AND EXTERNSHIPS, BRONX HOSPITAL

THERE are several volunteerships and externships available for recent graduates at the dental clinic, Bronx Hospital, in the following departments: oral surgery and exodontia, operative dentistry, orthodontia, surgical periodontia and root canal therapy. Applicants address David Wurzel, director of the Dental Department, Bronx Hospital, 169th St. & Fulton Ave., Bronx, New York.

RESIDENCIES AND INTERNSHIPS

THERE will be available July 1 at the Sea View Hospital, New York, N. Y., two dental residencies and two dental internships for a one year period. The Sea View Hospital, probably the largest tuberculosis hospital in the world, offers exceptional opportunities in most phases of dentistry. The dental residencies include a stipend of $1,200 annually plus maintenance; the internships, a stipend of $15 monthly plus maintenance. Applica-

tion forms can be obtained from the medical superintendent, Sea View Hospital, Staten Island, New York.

RALPH HOWARD BRODSKY, *Director,*
Division of Oral Surgery.

CARNEGIE FELLOWSHIPS FOR RESEARCH AND GRADUATE WORK IN THE DENTAL SCIENCES

AIDED by the Carnegie Corporation of the New York and the Eastman Dental Clinic, the School of Medicine and Dentistry of the University of Rochester offers scholarships paying $1,200-$1,800 per annum to well-trained dental graduates who are interested in research or who desire special training in the basic medical sciences as an aid to dental teaching or practice. A few fellowships also offer part-time training in oral surgery. On appointment, the applicant is given the title of Fellow in Dentistry and, according to his interest, works as a graduate student in one of the departments of the medical schools. Here, excellent laboratory facilities, adequate direction and close contact with various investigations related to medicine and dentistry help his research and study. Fellows are encouraged to attend medical classes, seminars and staff meetings and, when opportunity presents itself, to participate in class instruction and scientific meetings. Contact with the problems of clinical dentistry may be maintained through the Oral Surgery Clinic of the Strong Memorial Hospital and the Rochester Dental Dispensary. With the approval of the Graduate Council of the university, Fellows may prepare themselves for the degree of M.S. or Ph.D. Applications should be made to

GEORGE H. WHIPPLE, *Dean,*
Rochester, N. Y.

UNITED STATES PATENTS APPLICABLE OR PERTAINING TO DENTISTRY ISSUED DURING APRIL AND MAY 1943

April 6

2,315,503, WALTER S. CROWELL AND GEORGE W. BIRCH. Art of molding composite resins.

2,315,660, BENJAMIN F. SAHR. Clamp for dental impression trays.

2,315,669, ABRAHAM H. TAMARIN. Artificial tooth.

2,315,748, MORRIS J. THOMPSON. Method of and apparatus for taking impressions of cavities for dental inlays.

2,315,876, CECIL SPENCER SIVIL, EDWARD O. LIEBIG AND ROBERT ST. CLAIR LOW. Casting of metal alloys.

April 13

2,316,631, JACOB D. SCHWARTZ. Method of and apparatus for making dentures.

April 20

2,317,002, GEORGE ULVICK. Toothbrush.

2,317,008, WILBERT A. WERNER. Dental restoration.

2,317,103, IDA L. MEIER. Manufacture of dental crowns.

2,317,111, LUDWIG F. PERWAS. Tooth cover fastener.

2,317,123, HAROLD WARP. Toothbrush.

2,317,297, ALLEN LLEWELLYN OMOHUNDRO AND EMIL CONRAD FANTO. Dentifrice.

April 27

2,317,483, ALEXANDER RAKOS. Method of welding, soldering and fusing metals together.

2,317,485, THEODORE H. RIDER. Brush.

2,317,558, ARTHUR E. SMITH. Hypodermic syringe construction.

2,317,648, IVAR E. SIQVELAND. Process and apparatus for producing intraosseous anesthesia.

May 4

2,317,971, ROBERT C. ANGELL. Dental equipment stand.

2,318,001, JOHN A. LINDE. Orthodontic appliance device.

2,318,365, BIGELOW BOYSEN. Dental and mouth cleansing means.

2,318,402, KARL AXEL SAM KARLSTROM. Preparation of dental bridge and prosthesis.

2,318,403, KARL AXEL SAM KARLSTROM. Device for the parallel guidance of dental tools.

May 11

2,318,635, FRED SALINGER. Fountain toothbrush.

2,318,845, RAY C. FEAGIN AND CHARLES H. PRANGE. Dental resin.

May 18

2,319,205, FOSTER BUCK. Electrically operated toothbrush.

2,319,328, ALOIS KALTENBACH. Angle piece.